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NUCLEAR SCIENCE ABSTRACTS

Volume 29 Number 2

Abstracts 2413-4787

January 31, 1974

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Volume 29, Number 2, January 31, 1974

NUCLEAR SCIENCE ABSTRACTS

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Published by the USAEC Technical Information Center, Robert L. Shannon, Manager.

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the USAEC Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

- Atomic Energy of Canada Limited
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- Zentralstelle für Atomkernenergie-Dokumentation (West Germany)

Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

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INDEXES TO NSA

Comprehensive indexes appear in each issue and are cumulated at the end of each volume. The report number indexes will be cumulated on both a volume and two-volume basis. Multivolume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

COX, S.H, DNA replication of induced prophage in
  Haemophilus influenzae, 28:18453
CRANDALL, J.L, Californium-252 neutron sources, 28:18415
  (DP-MS-72-45)
CRAWFORD, J.F, Electron multiplication in cavities,
  28:18990

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

REACTORS/RESEARCH PROGRAMS
  Institute of Nuclear Research two-year-book, 1970--1971,
  28:19902 (INR--1410)
RED DWARF STARS/STAR EVOLUTION
  Perturbing aspects of the companions of Barnard's star,
  28:19287
REFRACTORIES/ELECTRON MICROSCOPY
  Electron microscope for investigation of metals at high
  temperature, 28:18834

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

19981 (ORNL-4804) ^{238}U NEUTRON ELASTIC-SCATTERING CROSS SECTIONS FROM 6.44 TO 8.56 MeV. Kinney, W. E.; Perey, F. G. **(Oak Ridge National Lab., Tenn.).** Jun 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
  ^{238}U neutron elastic-scattering cross sections from 6.44
  to 8.56 MeV, 28:19981 (ORNL-4804)
  Analytical techniques for determining levels and fates of
  trace elements in a fossil-fueled steam plant,
  28:17850 (CONF-730817-1)

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Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

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AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 2555, 2999, 4366, and 4744.

2413 (CONF-730324-) TRANSACTIONS, ANS NIAGARA-FINGER LAKES SECTION STUDENT CONFERENCE, MARCH 9–10 1973. (McMaster Univ., Hamilton (Ontario)). 1973. 52p.

The conference included 15 papers. Separate abstracts were prepared for all papers. (JFP)

For abstracts of individual papers see: 2418–2420, 2604, 2679, 3176, 3184, 3324, 4299, 4476, 4477, 4501, 4521, 4534, and 4557.

2414 (ICP-1033) ANALYTICAL CHEMISTRY BRANCH ANNUAL REPORT, FISCAL YEAR 1973. Shank, R. C. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs–Operations Office). Oct 1973. Contract AT(10-1)-1375. 133p. Dep. NTIS $5.45.

The Analytical Chemistry Branch Annual Report presents the nonroutine, significant analytical services and supporting development work for FY-1973. The analytical and technical support activities for the Idaho Chemical Programs and other NRTS and outside contractors include mass spectrometry, gas chromatography, atomic absorption spectrophotometry, emission spectrography, x-ray diffractometry, radiochemistry, spectrophotometry, titrimetry, gravimetry, coulometry, quality control, and remote techniques. Improvement of equipment, analytical techniques, and methods are a significant part of this report. (auth)

2415 FLUORINE. O'Donnell, T. A. (Univ. of Melbourne). pp 1009-1106 of Comprehensive Inorganic Chemistry. Volume 2. Trotman-Dickenson, A. F. Oxford; Pergamon Press Ltd. (1973).

A review is presented on fluorine that includes discovery, occurrence and industrial applications; production; manipulation of fluorine and fluorides in the laboratory; fluorine isotopes; physical properties; chemical reactivity; biological activity of fluorides; analytical chemistry; hydrogen fluoride solvent system; ionization in halogen fluorides; fluorides of main group elements; and chemical reactivity of higher fluorides of d- and f-transition elements. (200 references) (DHM)

Activation and Nuclear Reaction Procedures

Refer also to abstract 4007.

2416 (BMFT-FBK-73-23) ACTIVATION ANALYSIS. Proceedings of the Third Seminar, Karlsruhe, May 30–31, 1972. Vogg, H. (ed.). (Kernforschungzentrum Karlsruhe (F.R. Germany). Lab. fuer Isotopentechnik). Aug 1973. 57p. (In German). (CONF-7205100- (Absts)). Dep. NTIS (U. S. Sales Only) $5.00.

The 3rd seminar on "Activation Analysis," organized at the Karlsruhe Nuclear Research Center on May 30/31, 1972 exclusively dealt with reactor neutron activations. The four main topics treated in 28 individual contributions were: (a) practical aspects of neutron activation analysis, including its applications in industry. (b) Neutron activation analysis in geology, geochemistry, and cosmochemistry. (c) Neutron activation analysis in biological systems. (d) Computer controlled evaluations of gamma spectra. The summaries of the individual contributions have been included in these proceedings. Nearly 100 participants attended the meeting. The Laboratory of Isotope Technology of the Gesellschaft fuer Kernforschung mbH, Karlsruhe, was responsible for the organization. (auth)

2417 (CONF-721069-30) DETERMINATION OF Zn AND Cu IN THE PERIPHERY NERVES OF RATS SUFFERING FROM SULFUR AND CARBON NEUROPATHY. Kotas, P.; Obrusnik, I.; Lukas, E.; Krivanek, M. (Tesla, Prague (Czechoslovakia). Vyzkumny Ustav pro Sdelovaci Techniku; Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia); Institut Hygieny a Epidemiologie, Prague (Czechoslovakia)). 1972. 10p. (In French). Dep. NTIS (U.S. Sales Only) $3.00.

From international colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

Activation analysis techniques were used to determine Zn and Cu in the periphery nerves of rats exposed to carbon sulfides. The dissectioned nerves were irradiated with neutrons and mineralized. The Zn and Cu were simultaneously extracted using a dithizone–carbon tetrachloride solution. The results demonstrate a significant increase in the Cu contents and a much less marked change in the Zn contents. (FR)

2418 (CONF-730324-, pp 1-2) ANALYSIS OF TRACE ELEMENTS IN AIR-BORNE PARTICULATES BY NEUTRON ACTIVATION AND GAMMA RAY SPECTROMETRY. Priorello, P. (Univ. of Toronto). 1973.

From ANS Niagara–Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

2419 (CONF-730324-, pp 18-20) NEUTRON ACTIVATION ANALYSIS OF PRECIOUS METALS IN DEEP-SEA SEDIMENTS. Kuo, H. Y. 1973.

From ANS Niagara–Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

2420 (CONF-730324-, pp 24-26) DETERMINATION OF CADMIUM IN ENVIRONMENTAL SAMPLES BY NEUTRON AND PHOTON ACTIVATION ANALYSES. Chattopadhyay, A. (Univ. of Toronto). 1973.

From ANS Niagara–Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

2421 (EUR-5045) COMPUTER ASSISTED GAMMA SPECTROMETRY AT THE ISPRA JOINT RESEARCH CENTRE. Bertozzi, G.; Di Cola, G.; Girardi, F.; Guzzi, G. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Oct 1973. 22p. (In French). Dep. NTIS (U.S. Sales Only) $3.25. EUR FB 40,-.

Developments in computer handling of gamma spectrometric data for activation analysis at the Joint Nuclear Research Centre of Ispra are reviewed. Comparative performances in routine practical applications of various data handling systems are discussed. They are: (1) acquisition of gamma spectrometric data on tapes, and analysis "batchwise" by means of a large computer (IBM 370/165); (2) On-line connection with a large computer by means of an interactive teleprocessing system (IBM 1070 plus IBM 2741), time-shared among different users; (3) Use of a VIDEO IBM 2250 unit for interactive graphic analysis of gamma spectra and for a more sophisticated treatment of the data stored in the central computer; (4) Use of a 8 K memory minicomputer installed at the Laboratory and employed both as data acquisition device and as data processing tool. The philosophy of data handling for the different systems is the same, although the actual programs are very different. Multi-element quantitative analyses are based on the use of "oriented libraries" which are prepared by the analyst for each particular application. A special effort has been devoted to the development of software packages to be used in the small partition of the computer memory devoted to the teleprocessing and in minicomputers. Both hardware and software of the systems are described, with emphasis on their practical use, advantages, and disadvantages in various typical applications. (auth)

2422 (ITJ-38) PROPOSAL OF A CRITERION FOR REJECTING OUTLIERS. Taczanowski, S. (Akademia Gorniczo Hutnicza, Krakow (Poland). Instytut Techniki Jadrowej). Mar 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

A proposal is given of a simple criterion for rejecting the outliers, which is based on the intervals that should contain a given number of observations with the predetermined probability. The criterion is restricted to the normal populations to be tested. The tolerance limits are presented in the enclosed tables and the test procedure is suggested. The criterion has been applied in the program of activation analysis data processing. (auth)

2423 (MLM-2086) COMPARISON OF OXYGEN DETERMINATION METHODS FOR Ta−10W ALLOY. Woltermann, H. A.; Nunn, E. B.; Redding, P. L.; Ryan, R. L.; Jarvis, J. Y.; Hamman, R. D. (Mound Lab., Miamisburg, Ohio (USA)). 13 Nov 1973. Contract AT-33-1-GEN-53. 8p. Dep. NTIS $4.00.

The relative merits of present analytical methods for the determination of oxygen in tantalum alloys were evaluated at Mound Laboratory. Standards were prepared by doping Ta−10 wt % W alloy with approximately 200, 400, 600, and 1000 μg of oxygen per gram of metal. Methods evaluated included: inert-gas fusion using induction heating; inert-gas fusion using high amperage current; vacuum fusion; and neutron activation analysis. The inert-gas fusion using high amperage current yielded the best results and the equipment for this method was subsequently modified for use in the analysis of both radioactive and nonradioactive samples. (auth)

2424 COMPUTER PROGRAM FOR DETERMINATION OF CONCENTRATIONS OF TRACE ELEMENTS IN COMPONENTS OF WATER SYSTEMS BY NONDESTRUCTIVE ACTIVATION ANALYSIS. Slavic, I.; Draskovic, R.; Tasovac, T.; Radosavljevic, R. (Boris Kidric Inst. of Nuclear Research, Belgrade). Isotopenpraxis; 9: No. 3, 87-91(Mar 1973). (In German).

A computer program for the determination of trace elements in components of the water systems (bed material, suspended material, dissolved substances, plankton, algae) by nondestructive activation analysis was developed. Results of the determination of Cr, Sb, Sc, Fe, Co, Na, and La concentrations in suspended materials from the Danube river, obtained by interpretation of data with a CDC-3600 computer (64 k words), are presented. (auth)

2425 INSTRUMENTAL ACTIVATION ANALYSIS OF ATMOSPHERIC POLLUTANTS AND POLLUTION SOURCE MATERIALS. Gordon, G. E. (Univ. of Maryland, College Park). pp 138-143 of Identification and Measurement of Environmental Pollutants. Westley, B. (ed.). Ottawa; National Research Council of Canada (1971).

From international symposium on identification and measurement of environmental pollutants; Ottawa, Canada (14 Jun 1971). See CONF-710668-.

With the use of high-resolution (Ge(Li)) detectors, one can identify and measure intensities of γ rays from neutron-irradiation products of many trace and minor elements in complex samples without chemical separations. Concentrations of 24 elements (Na, Ca, Ba, Al, Sc, V, Mn, Fe, Co, Ni, Cu, Zn, Se, Sb, Cl, Br, La, Ce, Sm, Eu, Yb, Lu, Hf, and Th) on aerosols collected on Millipore filters can be measured by neutron irradiation of the filters and observation of their γ rays with Ge(Li) detectors. Concentrations of the same elements in pollution source materials (petroleum products, coal, rubber) can similarly be measured. By simultaneously observing so many elements in each aerosol or pollution source sample, we expect to develop chemical fingerprints, i.e., elemental concentration patterns characteristic of each air pollution source. Fingerprints may be used to identify the major contributors of air pollutants of a region, to follow the movement and mixing of polluted air masses, and to observe chemical reactions of pollutants. (auth)

2426 IDENTIFICATION AND MEASUREMENT OF TRACE ELEMENTS IN FRESH WATER BY NEUTRON ACTIVATION. Merritt, W. F. (Chalk River Nuclear Labs., Ont.). pp 358-362 of Identification and Measurement of Environmental Pollutants. Westley, B. (ed.). Ottawa; National Research Council of Canada (1971).

From international symposium on identification and measurement of environmental pollutants; Ottawa, Canada (14 Jun 1971). See CONF-710668-.

A system for analyzing trace elements in fresh water without using chemical separation is described. By making use of: the high neutron flux of the NRU reactor (2×10^{14} n/cm²/s); selected irradiation times; selected decay periods; a large Ge(Li) detector with good resolution; and computer programs to identify γ-ray peaks and compute peak areas, it has been possible to identify and measure more than 20 elements in fresh water samples without the need for chemical separations. Samples (≈100 ml) are freeze-dried, transferred to plastic irradiation capsules, and analyzed by neutron activation and gamma-ray counting, using the techniques described. Typical trace element contents of waters from several small lakes and from the Ottawa River are presented. The factors influencing detectable levels are discussed. (auth)

2427 DETERMINATION OF SEED NITROGEN CONTENT BY $^{14}N(\gamma,n)^{13}N$ ACTIVATION ANALYSIS. Niemann, E. G.; Neumueller, D. (Institut fuer Strahlenbotanik der Gesellschaft fuer Strahlen und Umweltforschung mbH, Hanover). pp 339-346 of Nuclear Techniques for Seed Protein Improvement. Vienna; International Atomic Energy Agency (1973).

From research coordination meeting on nuclear techniques for seed protein improvement; Neuherberg, F.R. Germany (26 Jun 1972). See STI/PUB-320; CONF-720694-.

The methodological aspects of the determination of protein content in seeds by activation with high-energy γ rays are discussed. It has been found that interference by certain other elements may be eliminated by a 10-min storage time after sample activation. Analytical results for total nitrogen obtained by the γ-activation method were generally about 2 to 10% higher than those from and by the conventional Kjeldahl procedure. Measurements were done on seven species of cereals and legumes, a total of 21 varieties. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 2553, 2584, and 4787.

2428 (BARC-669) SPECTROGRAPHIC DETERMINATION OF TRACE IMPURITIES IN MAGNESIUM METAL. Krishnamurty, G.; Gopal, K. S.; Krishnan, S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 17p. Dep. NTIS (U.S. Sales Only) $3.00.

An emission spectrographic method is described for the quantitative estimation of seventeen trace impurities in magnesium metal in the concentration range 0.5 to 500 ppM. The spectra are excited in a 10 amp dc arc and are recorded on a Hilger large quartz spectrograph in the region 2410 to 3360 Å. Sodium fluoride is used to suppress the intense background. Gallium is used as the internal standard. The mean standard deviation for various elements varies from 10 to 20%. (auth)

2429 (BARC-680) SPECTROGRAPHIC ANALYSIS OF HIGH-PURITY ANTIMONY FOR SEVENTEEN TRACE IMPURITIES. Sreeramamurty, P.; Marathe, S. M.; Kapoor, S. K.; Saraswathy, M. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 19p. Dep. NTIS (U.S. Sales Only) $3.00.

A dc arc spectrographic method to determine impurities like B, Ni, Pb etc. in high-purity Sb is described. Antimony metal powder was mixed with pure conducting graphite powder in the ratio 10 : 1 by weight and fifty milligrams of this mixture was arced at 10 amp dc in oxygen atmosphere using Stallwood-jet assembly. The spectra were recorded in the first order of a JACO Ebert plane grating spectrograph using 1200 lines/mm grating blazed at 3300 A. Chromium was used as internal standard element. The sensitivity of analysis ranges from 1×10^{-5} to 10^{-3}%. (auth)

2430 (BARC-684) SPECTROSCOPY DIVISION ANNUAL PROGRESS REPORT FOR 1972−1973. Kartha, V. B.; Narasimham, N. A. (eds.). (Bhabha Atomic Research Centre, Bombay (India)). 1973. 75p. Dep. NTIS (U. S. Sales Only) $5.75.

Progress is reported in the following general areas of research: analysis of high purity and reactor grade materials; atomic, molecular, and solid state spectroscopy; optics; and service electronics. Work carried out during 1972-73 in each of these areas is reported. (ERB)

2431 (CENA-BC−1) MEASUREMENT OF THE NATURAL VARIATION OF THE D/H RATIO IN WATER SAMPLES. Matsui, E.; Salati, E.; Ferraz, E. S. B. (Centro de Energia Nuclear na Agricultura, Sao Paulo (Brazil)). 1 Jul 1971. 31p. (In Portuguese). INIS.

For the purpose of measuring the natural variations of deuterium concentration in water samples by the mass spectrometer, a water decomposition system was built, using uranium metal as a reducing agent. The Toepler pump, initially used for transferring the hydrogen gas into a sample tube was replaced by a pumping system utilizing uranium metal. A varian-Mat mass spectrometer, model GD-150, especially designed for measurement of the variation of the D/H ratio, was used for this work. (INIS)

2432 (IEA-285) INDIRECT DETERMINATION OF IODINE IN ORGANIC COMPOUNDS BY ATOMIC ABSORPTION SPECTROPHOTOMETRY. De Almeida, M. A. T. M.; De Moraes, S.; Barberio, J. C. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jan 1973. 10p. (In Portuguese). Dep. NTIS (U.S. Sales Only) $3.00.

A method is presented for the determination of iodine in organic compounds by atomic absorption spectrophotometry. An aliquot of the organic compounds is treated with sodium peroxide, potassium nitrate, and saccharose in the Wurtzschmitt micropump and iodine is reduced from iodate to iodide, being the last precipitated with silver nitrate as silver iodide in acid medium. Silver iodide is then dissolved in excess of potassium iodide. Silver is determined in this solution with a hydrogen-air flame in a total consumption burner (HETCO). The process has a good sensitivity for silver (0.1 ppM) and consequently for iodide. (auth)

2433 (KFK-1678) ROUTINE METHOD FOR THE ANALYTICAL DETERMINATION OF THE FLUORIDE CONTENT OF PUREX PROCESS SOLUTIONS. Ertel, D.; Knittel, G.; Herling, I. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Heisse Chemie). Jul 1973. 23p. (In German). Dep. NTIS (U.S. Sales Only) $3.25.

The fluoride content of aqueous and organic PUREX process solutions can be determined with good reproducibility and accuracy. The method includes a distillation separation of fluoride and its subsequent electrometric determination using a fluoride-selective electrode. The analytical range covers 5 to 500 micrograms fluoride per aliquot and the concentration limit is 5×10^{-5}M (1 ppM). Complexing cations like Al(III), Zr(IV), La(III), and U(VI) do not interfere. (auth)

2434 (UCRL-74695) DETERMINATION OF TRACE NOBLE GASES IN AIR AND NATURAL GAS. Newton, J. C.; Stephens, F. B.; Stump, R. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1973. 21p. (CONF-730915-8). Dep. NTIS $3.25.

From symposium on noble gases; Las Vegas, Nevada, USA (24 Sep 1973).

A method was developed for the analysis of air and natural gas samples containing trace amounts of noble gases. The gas samples are preconcentrated by reaction with calcium at 900 to 1000°C and analyzed by mass spectrometry on an automated instrument. Methods of relating the concentrated sample to the original sample and the preparation of gas standards are given. The accuracy of the technique at the 25 ppM level was determined. The precision of the method and requirements for improving the technique are also discussed. (auth)

2435 SOME PROBLEMS OF THE DETERMINATION OF THE NITROGEN MASS IN SAMPLES ENRICHED WITH ^{15}N. Krawielitzki, K. (Forschungszentrum fuer Tierproduktion Dummerstorf, Rostock, Ger.). Isotopenpraxis; 9: No. 5, 171-173(May 1973). (In German).

As a rule, the equivalent weight of nitrogen is said to be 14.008. However, this is right with regard to nitrogen having normal isotopic composition (^{14}N = 99.63%, ^{15}N = 0.37%). The equivalent weight of nitrogen depends on its isotopic composition; it may rise up to 15.005, i.e., by 7%, when nitrogen is enriched with ^{15}N. This dependence of nitrogen equivalent weight from its isotopic composition has to be taken into regard when the total nitrogen mass and the ^{15}N mass are to be determined, or when the mass of compounds labelled ^{15}N is to be found out. At this, deviations from the known correction formulae, derived for gravimetric determination purpose, arise owing to the fact that the Kjeldahl nitrogen determination method is based on measurement analysis. The related correction formulae are derived, and it is recommended not to use mg or g for characterizing ^{15}N masses, but to introduce the units mmol or mol which are due to titrimetric determination and independent from nitrogen equivalent weight. (auth)

2436 SELENIUM, TELLURIUM, AND POLONIUM. Bagnall, K. W. (Univ. of Manchester, Eng.). pp 935-1008 of Comprehensive Inorganic Chemistry. Volume 2. Trotman-Dickenson, A. F. Oxford; Pergamon Press Ltd. (1973).

Selenium, tellurium, and polonium are discussed with respect to history, occurrence, and distribution, production, industrial uses, purification, allotropy, nuclear properties, physical properties, chemistry, health hazards, and analytical chemistry. Information is also given on selenium, tellurium, and polonium compounds. (453 references) (DHM)

2437 DETERMINATION OF IMPURITIES IN HIGH PURITY TELLURIUM. IV. Determination of Sodium Traces by the Method of Flame Photometry. Szwabski, S.; Dobrowolski, J. (Technical Univ., Gdansk, Poland). Chem. Anal. (Warsaw); 18: No. 5, 942 (1973). (In Polish).

Sodium was determined with the flame method. Methods of concentrating traces in two sorts of tellurium (99.8% and 99.999%) were elaborated. In the former case precipitation of tellurium in form of a hardly soluble oxide was used. The sample was placed in a quartz beaker, dissolved in aqua regia. Nitric acid was removed by repeated evaporation with concentrated hydrochloric acid. The final solution containing a small quantity of the latter was diluted with water, thus causing tellurium dioxide precipitation. The solution contained concentrated impurities, among others sodium, the recuperation of which was 94% on the average. The solution decanted from over the precipitate was placed in a measuring flask and analyzed by the method of flame photometry in order to determine sodium. In case of 99.999% purity tellurium, a sample of the element was placed in a quartz pipe on a boat of the same material. Chlorine was passed through the pipe heated to about 420°C. Gaseous tellurium tetrachloride formed under these conditions was transferred together with the chlorine flow to a cooled receiver. In this manner concentrated traces of sodium and of other impurities remaining in the pipe were washed away by means of 2 M HCl to a quartz beaker. The solution obtained was evaporated to a volume of 10 ccm, placed in a measuring flask of 25 ccm capacity and analyzed by the method of flame photometry taking into consideration the blank test prepared in a similar manner. Sodium determination was made by the method of limiting solutions. All the operations were carried out using bidistilled water and acids of special purity. Chlorine was purified by passing it through washers with water and concentrated sulfuric acid. The following quantities of sodium were determined: in 99.8% tellurium 1.05×10^{-2}%, in 99.999% tellurium — 3.7×10^{-4}%. Statistical analyses displayed a very good reproducibility of results obtained by means of methods elaborated. (auth)

2438 URANIUM OCCURRENCE IN PHOSPHATIC REMAINS OF FOSSIL FISH. Kochenov, A. V.; Dubinchuk, V. T.; Germogenova, E. V. Sov. Geol.; No. 3, 69-77(Mar 1973). (In Russian).

The uranium content of fossil fish was studied by phase analysis selective solution, and electron microscopy. In phosphate residues buried among sulfide-bearing dark clays under strong reducing conditions, a large part of the uranium is present as pitchblende. Experiments on precipitation of uranium from water solution were carried out. The results of studies on the form of uranium in mineralized fossils showed that in fossilization of bone tissue and recrystallization of calcium phosphate, separation of U^{4+} in the solid phase (uraninite) along with other compounds is possible. Isomorphic introduction of tetravalent uranium into the apatite structure apparently occurs only with low uranium contents. (tr-auth)

2439 INFLUENCE OF VARYING ^{18}O CONTENTS ON THE REFRACTOMETRIC AND SPECTROPHOTOMETRIC D DETERMINATION IN WATER. Baertschi, P.; Keil, R. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). Z. Anal. Chem.; 266: No. 4, 264-267(1973). (In German).

The influence of varying ^{18}O contents on the D analysis of water by some optical methods was investigated by means of highly enriched $H_2{}^{18}O$ and $D_2{}^{18}O$. The instrumental error of ± 0.1% D in the refractometric D analysis of water was found to correspond to differences of ± 6 atom % ^{18}O in H_2O and ± 20% ^{18}O in D_2O. The sensitivity of several spectrophotometric methods of D analysis to differences in ^{18}O content is determined on the basis of differential spectra between $D_2{}^{18}O$ and $D_2{}^{16}O$ and $H_2{}^{18}O$ and $H_2{}^{16}O$, respectively. Wavelengths for minimum interference of ^{18}O content with D analysis are given and possibilities of spectrophotometric ^{18}O analysis are discussed. (auth)

2440 DISTRIBUTION OF URANIUM IN FOSSIL BONE DETRITUS. Rekharskaya, V. M.; Polupanova, L. N. Izv. Akad. Nauk SSSR, Ser. Geol.; No. 3, 122-129(Mar 1973). (In Russian).

To determine the precise role of calcium bone detritus and organic substances in uranium accumulations, individual bones and concentrates of bone residues from sedimentary rock made up of clay minerals, pyrites, calcites, and quartzes were studied. Bone detritus was represented by shells of bony skeletons and integumentary parts of fossil fish, among which were bones of the head, fins, ribs, teeth, vertebrae, and scales. Detailed chemical-mineralogical studies were made by x-ray structural analysis, micro-radiography, and centrifugal methods. It was established that fragments of uranium-containing bones of the skeleton and integumentary parts of fossil fish were made up of 96.4% fluoroapatite and only 3.6% organic matter. Uranium was higher in the bones with a higher organic content. The coefficient of correlation (0.932) indicated a direct relation between the organic content and the uranium. The P_2O_5-uranium correlation was

0.097. Organic matter in bone is the chief component causing concentration and the specificity of distribution of uranium in bone detritus. The uranium in bone is apparently sorbed on the humic substances. (tr-auth)

2441 POSSIBILITY OF APPLICATION OF METALLIC URANIUM AS A REDUCING AGENT FOR TRITIATED WATER. Hadzisehovic, M. (Boris Kidric Inst., Belgrade); Milojevic, A.; Bek-uzarov, D.; Mocilnik, I. Nucl. Instrum. Methods; 112: No. 1-2, 73-74(1973).

Some of the results of the investigation of the possibility of using uranium metal as a reducing agent for conversion of tritiated water to hydrogen are reported. It is found that water is reduced quantitatively by passing steam over heated uranium metal turns in vacuum at temperatures of 450 to 600°C and that the hydrogen yield is quantitative within the limits of experimental error of determination of 0.7%. The reduction of water gives pure hydrogen in the temperature interval investigated. Hydrogen is formed by thermal dissociation of previously produced uranium hydride, which is an intermediate of reaction of water with uranium. (auth)

2442 SPECTROCHEMICAL METHOD FOR DETERMINING THE COMPOSITION OF NATIVE GOLD. Sutton, A. L.; Havens, R. G.; Sainsbury, C. L. J. Res. U. S. Geol. Surv.; 1: No. 3, 301-307(1973).

The spectrochemical method described herein for determining trace, minor, and major element distribution in native gold is applicable over a wide range of particle sizes and over a very large concentration range. The matrices of samples and standards are very closely matched. The method was tested on 100 nuggets from a gold sample collected in Alaska. The data show that the method is adequate for 30 of the 31 elements checked; only the mercury values are not acceptable. The data also show that more than one sample is necessary for a complete evaluation of all elements in one geologic location. (auth)

2443 DETERMINATION OF TRACE METALS IN NATURAL WATERS. Chau, Y. K. (Canada Centre for Inland Waters, Burlington, Ont.). pp 354-357 of Identification and Measurement of Environmental Pollutants. Westley, B. (ed.). Ottawa; National Research Council of Canada (1971).

From international symposium on identification and measurement of environmental pollutants; Ottawa, Canada (14 Jun 1971). See CONF-710668-.

Determination of trace metals in the aquatic ecosystem has become an important area of pollution studies. The demand for knowledge of a particular element of interest has already reached a stage that knowledge of only the total concentration of the element is no longer satisfying, but, in addition, its chemical speciation in which it exists, such as complexes or hydrated ions, dissolved or associated with particulate matter, and its valence state are relevant to many environmental studies. When such information is required, the validity of a single sensitive method is greatly reduced. While atomic absorption, flame emission, and colorimetry are still enjoying popularity, several electroanalytical techniques such as specific-ion electrode, polarography, and inverse polarography will definitely find increasing use. Techniques for trace metal determination and trends in trace element research are discussed. (auth)

2444 DETERMINATION OF INORGANIC POLLUTANTS OF AIR AND WATER BY SPARK SOURCE MASS SPECTROMETRY. Brown, R.; Vossen, P. G. T. (AEI Scientific Apparatus Ltd., Manchester, Eng.). pp 427-431 of Identification and Measurement of Environmental Pollutants. Westley, B. (ed.). Ottawa; National Research Council of Canada (1971).

From international symposium on identification and measurement of environmental pollutants; Ottawa, Canada (14 Jun 1971). See CONF-710668-.

The application of spark source mass spectrometry to the analysis problems of environmental pollution is relatively new. The need to carry out all element survey analyses of airborne particulate matter has prompted the work reported. The choice of spark source mass spectrometry was made largely because of the complete element survey capability and high sensitivity of this method. The authors' involvement in pollution analysis began with the investigation of the composition of airborne particulate matter in the atmosphere of the City of New York. In later investigations, particulate matter was analyzed to investigate the contribution to the atmosphere of industrial emission. More recently, work has been carried out on pollution of rivers and streams in Europe and the United States. It is apparent that detection limits of one nanogram per millilitre may be achieved without preconcentration of sample. The determination of mercury in river sediment mud samples has been an area of particular interest over the last year. Work will be reported in all these fields of activity. (auth)

2445 WATER AND WATER POLLUTION HANDBOOK. Volume 4. Ciaccio, L. L. (ed). New York; Marcel Dekker, Inc. (1973). 641p. $29.50.

Separate abstracts were prepared for four of the nine chapters in this book. The other chapters discuss the monitoring of water systems and methods of water analysis including automated and instrumental methods, gas chromatography, infrared spectroscopy, and luminescence techniques. (ERB)

For abstracts of individual chapters see: 2446–2448, and 2462.

2446 DETERMINATION OF MINOR METALLIC ELEMENTS IN THE WATER ENVIRONMENT. Cosgrove, J. F.; Bracco, D. J. (GTE Labs., Inc., Bayside, NY). pp 1315-1356 of Water and Water Pollution Handbook. Vol. 4. Ciaccio, L. L. (ed.). New York; Marcel Dekker, Inc. (1973).

A group of analytical methods available for minor component analysis–methods that are not covered elsewhere in this handbook are presented. Of the methods presented, the three flame methods are single-element methods applicable at this point, to multielement analysis only on an element by element basis. Attempts are being made to convert these techniques to multielement methods. Emission spectroscopy is inherently a comprehensive method. X-ray spectroscopy and activation analysis with the proper instrumentation can both be comprehensive. These last methods are then capable of providing maximum information on a sample in a single analysis. It is difficult to recommend any one technique. Since no analytical method is applicable to all analytical problems, the choice of method must depend on the problem at hand. (auth)

2447 MASS SPECTROMETRY IN WATER ANALYSIS. Roboz, J. (Air Reduction Co., Inc., Murray Hill, NJ). pp 1617-1661 of Water and Water Pollution Handbook. Vol. 4. Ciaccio, L. L. (ed.). New York; Marcel Dekker, Inc. (1973).

The instrumentation, techniques, and applications of mass spectrometry in water analysis are discussed. The techniques include electron bombardment, GC-MS combination, stable isotope dilution, and vacuum spark methods. Applications include analysis of inorganic gases, organic compounds, and elemental impurities. (ERB)

2448 ELECTROCHEMICAL TECHNIQUES IN WATER ANALYSIS. Maienthal, E. J.; Taylor, J. K. (National Bureau of Standards, Washington, DC). pp 1751-1800 of Water and Water Pollution Handbook. Vol. 4. Ciaccio, L. L. (ed.). New York; Marcel Dekker, Inc. (1973).

The principles and applications of electrochemical techniques in water analysis are discussed. The techniques include: conductivity; potentiometry; amperometry; coulometry; chronopotentiometry; and voltammetry. (ERB)

Radiometric and Radiochemical Procedures

Refer also to abstracts 2538, 2693, 2694, 2702, 2721, 2726, 2765, and 2803.

2449 (BNWL-tr-94) CONTRIBUTION TO THE LIQUID SCINTILLATION COUNTING OF FILTER MATERIALS. Buchtela, K.; Tschurlovits, M. Translated by B. G. Russell from Int. J. Appl. Radiat. Isotop.; 24: 531-533(1973). 5p. Dep. NTIS $3.00.

Radioactive samples on optical transparent foils are counted with high efficiency (95 percent for thallium-204) by liquid scintillation. These transparent foils are obtained by moistening porous materials with solvents of suitable refractive index. This technique is of interest for measuring radioactive chromatograms, electropherograms, and aerosol filters. Several types of filter material were investigated. (auth)

2450 (COO-3563-12) DOUBLE TRACER STUDIES TO OPTIMIZE CONDITIONS FOR THE RADIOCHEMICAL SEPARATION OF PLUTONIUM FROM LARGE VOLUME SEA WATER SAMPLES. Livingston, H. D.; Mann, D. R.; Bowen, V. T. (Woods Hole Oceanographic Institution, Mass. (USA)). 1972. Contract AT(11-1)-3563. 14p. (CONF-7210109-1). Dep. NTIS $3.00.

From meeting on "reference methods for marine radioactivity studies: determination of transuranic elements, radioruthenium, and other radionuclides in marine environmental samples"; Vienna, Austria (30 Oct 1972).

A procedure for optimizing conditions for the radiochemical separation of plutonium from seawater is described in which ^{242}Pu is added to determine the overall recovery of Pu separated from the sample and the recovery of ^{242}Pu at any chosen point in the procedure is measured by the addition of a similar amount of ^{236}Pu at that point and the percentage of ^{236}Pu finally recovered is used to calculate the ^{242}Pu recovery at the time of ^{236}Pu addition. The experience gleaned from this double tracer experiment has permitted improvement in the ability to recover plutonium from

50 l seawater samples for α spectrometric analysis of $^{239/240}Pu$ and, in some cases, ^{238}Pu. (DHM)

2451 (DP-MS-73-35) DETERMINATION OF PHOSPHORUS-32 IN AQUEOUS ENVIRONMENTAL SAMPLES. Milham, R. C. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1973. Contract AT(07-2)-1. 13p. (CONF-731113-1). Dep. NTIS $3.25.

From American Chemical Society 25th annual southeastern regional meeting; Charleston, South Carolina, USA (7 Nov 1973).

An improved method for isolating and beta counting ^{32}P in aqueous environmental samples at the Savannah River Laboratory is described. Interference from ^{131}I is eliminated by a chloroform extraction and from ^{95}Zr-^{95}Nb by anion exchange with Dowex 1-X8 resin. Phosphorus-32 is separated from interferences such as ^{141}Ce, ^{144}Ce, ^{51}Cr, ^{137}Cs, and ^{140}Ba-^{140}La by extraction as phosphomolybdic acid with hexanol. This solvent is mixed with liquid scintillator and counted. Three improvements made in the method are: (a) using HCl gas to adjust the sample to 12M HCl to shorten the procedure, (b) replacing pentanol with hexanol to increase the extraction of phosphomolybdic acid, and (c) counting ^{32}P by liquid scintillation instead of on planchets. Decontamination of ^{32}P from interferences is about 10^4, and recovery is at least 85%. Analyses of control spikes during the past 30 months show the method to have a sensitivity of 14 pCi/l and a precision of 11% when using a 50 ml sample. (auth)

2452 (SLA-73-5531) ANALYSIS OF SILICON–GERMANIUM ALLOYS USED IN THERMOELECTRIC APPLICATIONS. Russell, J. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 26p. (CONF-731022-1; SLA-73-643). Dep. NTIS $3.50.

From invited lecture given at Bell Telephone Laboratories; Murray Hill, New Jersey, USA (16 Oct 1973).

Analytical procedures used in support of a thermoelectric alloy development program are described including dehydration with perchloric acid and subsequent volatilization; titration method; γ absorption spectroscopy; x-ray fluorescence analysis; and emission spectroscopy. Methods used to evaluate raw materials, assess process parameters, and to characterize the alloy are summarized. Emphasis is placed on advantages and disadvantages of the methods for a given determination, particularly with respect to the time required for an analysis, cost in man-hours, and the quality of the result in terms of accuracy and precision. Specific data are included to provide some indication of the efficacy of the methods. (auth)

2453 RADIOREAGENT METHOD OF ANALYSIS OF BORON IN SUB MICROGRAM RANGE. Menon, M. P. (Savannah State Coll., GA). J. Radioanal. Chem.; 14: No. 1, 63-70(Mar 1973).

A radioreagent method for the determination of boron in submicrogram range is described. This method is based on the reaction of boric acid with hydrofluoric acid labeled with ^{18}F and the measurement of the activity of the product, HBF_4^*, which is isolated by complexation with methylene blue and extraction with 1, 2-dichloroethane. The 0.51-MeV γ activity resulting from ^{18}F of an aliquot of the extract is found to be proportional to the amount of boron in the sample. It was found that at least 0.1 μg of boron can be measured by this method with an accuracy of about 5% error. The short-lived nature of ^{18}F makes it necessary that the analysis be performed as soon as the isotope is available. The sample to be analyzed should be freed from hydrofluoric acid as well as other species which form precipitate or complexes with Hf. The method was applied successfully to the analysis of one of the National Bureau of Standards reference samples. (auth)

2454 INTERNAL GAS COUNTING METHOD FOR ABSOLUTE MEASUREMENTS OF THE SPECIFIC RADIOACTIVITY OF TRITIATED WATER. Hadzisehovic, M. (Boris Kidric Inst., Belgrade); Mocilnik, I; Bek-uzarov, D. Nucl. Instrum. Methods; 112: No. 1-2, 69-71(1973).

The results of absolute determination of the specific radioactivity of tritiated water on the basis of the measured disintegration rate of tritium by the internal gas counting method are presented. Two reducing agents, uranium and zinc, were used to convert the water into the gaseous state. The absolute disintegration rate of tritium per unit of the effective volume of the counter is determined by a compensation method by using three gaseous proportional counters. The specific radioactivity of water is found in two ways, (depending on the manner of determining the mass of the radioactive hydrogen) which give the same result within the limits of 0.3%. The total error in the determination of specific radioactivity is ±1%. A standard of tritiated water given with the error of ±0.5% is used for the measurement. The standard is obtained from the Central Bureau for Nuclear Measurements, Euratom, Geel, Belgium. The standard value and the value of our measurements of specific radioactivity agree within ±1%. (auth)

2455 NON-DESTRUCTIVE DETERMINATION OF RADIONUCLIDES IN LUNAR SAMPLES USING A LARGE LOW-BACKGROUND GAMMA-RAY SPECTROMETER AND A NOVEL APPLICATION OF LEAST-SQUARES FITTING. Eldridge, J. S.; (Oak Ridge National Lab., TN); O'Kelley, G. D.; Northcutt, K. J.; Schonfeld, E. Nucl. Instrum. Methods; 112: No. 1-2, 319-322(1973).

Dual-parameter γ-ray spectrometer systems with large-volume NaI(Tl) crystals and ultra-low backgrounds have been used for the non-destructive determination of K, Th, U, and cosmic-ray produced radionuclides in 60 lunar samples. The total mass of samples measured with these systems is ~28 kg, and the individual sample masses varied from 2 to 2300 g. Samples from Apollo 11, 12, 14, 15, and 16 missions have been measured. Operation of the spectrometers in a coincidence mode and analyzing singles- and coincidence-spectra permit the simultaneous determination of 8 to 10 radionuclides in each lunar sample. (auth)

2456 PREPARATION OF MONOMOLECULAR RADIOACTIVE SOURCES. Dobrilovic, L.; Simovic, M. (Boris Kidric Inst., Belgrade). Nucl. Instrum. Methods; 112: No. 1-2, 359-366(1973).

A study of the physical state of monomolecular layers obtained under various conditions is presented. A method for the preparation of radioactive sources as monomolecular layers is described. A review is given of the problems associated with the preparation of such sources for the radionuclides, ^{3}H, ^{14}C, ^{32}P, ^{60}Co, ^{203}Hg, ^{51}Cr and ^{55}Fe, and detailed characteristics of monomolecular sources of the latter two radionuclides are presented. (auth)

2457 SPECIAL METHODS OF SOURCE PREPARATION. Lowenthal, G. C.; Wyllie, H. A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nucl. Instrum. Methods; 112: No. 1-2, 353-357(1973).

Conditions for radioactivity measurements are normally optimised by working with the thinnest practical sources prepared quantitatively from highly dilute solutions. When sources are required for special purposes, techniques different from the standard methods must be employed. For nuclear spectroscopy, minimum energy loss in the source is an overriding requirement. For other purposes it is the need for the reproducibility of the countrates registered by a given measuring system per unit mass of radioactive material in the source. A number of these source-making methods and the resulting source characteristics are reviewed and a new method is described where sources are made on thin pads of ion exchange resins electrosprayed from suspensions of finely ground particles (<0.3 μm) onto conventional metallised VYNS foils. (auth)

2458 PREPARATION OF THIN SOURCES: A REVIEW. van der Eijk, W.; Oldenhof, W.; Zehner, W. (Central Bureau for Nuclear Measurements, Geel, Belgium). Nucl. Instrum. Methods; 112: No. 1-2, 343-351(1973).

In nuclear spectroscopy thin, homogeneous and chemically and mechanically stable sources are necessary to prevent spectrum distortion due to self-absorption. Similar source requirements pertain in the metrology of radionuclides that emit low energy radiation. A review is presented of methods and techniques used to obtain thin quantitative sources on both thin plastic and thick metallic backings for counting purposes, followed by a review of those used for the preparation of spectroscopical sources such as vacuum evaporation, electroplating, electrospraying, the use of mass separators, evaporation in a gas stream, etc. The qualities of the sources produced by these various methods are compared insofar as the available data allow. An extensive bibliography is included and catalogued. (auth)

2459 SAMPLING AND COUNTING TRITIATED WATER VAPOR FROM RADIOACTIVE OFF-GAS STREAMS BY ADSORPTION OF SILICA GEL. Filss, P. (Kernforschungsanlage, Juelich, Ger.). Radiochem. Radioanal. Lett.; 15: No. 3, 213-223(20 Oct 1973).

Tritiated water vapor in radioactive off-gas streams is determined by adsorption on silica gel and counted directly in a Tri-Carb liquid scintillation spectrometer. The tritium count rate varies with time as the tritium is extracted into the scintillator liquid and contains contributions from atoms adsorbed on the silica gel surface. (auth)

2460 USE OF RADIOACTIVE KRYPTONATE OF SILICA GEL IN THE CHEMICAL ANALYSIS. III. Test of the Possibility of Using Kryptonated Silica Gel in the Determination of Benzene and Carbon Tetrachloride. Naoum, M. M.; Tolgyessy, J.; Jesenak, V. (Slovak Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 15: No. 3, 193-199(20 Oct 1973).

Radioactive kryptonate of silica gel was applied to test the possibility of the determination of benzene and carbon tetrachloride in air by the radiorelease of ^{85}Kr. Compressed tablets of silica gel, previously kryptonated by micro-diffusion technique, were allowed to absorb different concentrations of benzene or carbon tetrachloride vapors in air during different periods of exposure. The relative residual activities were found to be slightly decreased independent of the concentration of vapor or period of exposure. This method was proved to be inconvenient for such determination. (auth)

2461 METODY OPREDELENIYA RADIOAKTIVNOSTI. (Methods of Determining Radioactivity). Polikarpov, G. G. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). 196p.

Chapters, by different authors, are included on biogeochemical problems of natural radioactivity, neutron background in and methods for studying heavy elements in the hydrosphere, radiometry of biological samples, simultaneous determination of ^{60}Co, ^{90}Sr, and ^{137}Cs in the environment, low background gamma spectrometry, determination of low concentrations of radon and of alpha-active elements in water, dielectric detectors for determining fissile elements, suppression of background in scintillation gamma spectrometry, detectors for small neutron fluxes, radioecology of fresh-water fish, alpha radiograpay of atmospheric objects, beta-counting efficiency in gas-discharge counters, designing of radiobiological experiments, natural radioactivity in a volcanic region, uranium determination in sea water and in sea organisms using neutron activation and dielectric detectors, and processing of complex gamma scintillation spectra. Chapters are well documented. (TTT)

2462 DETERMINATION OF RADIOACTIVE NUCLIDES IN WATER. Kahn, B. (National Environmental Research Center, Cincinnati). pp 1357-1388 of Water and Water Pollution Handbook. Vol. 4. Ciaccio, L. L. (ed.). New York; Marcel Dekker, Inc. (1973).

Analytical radiochemical procedures are available for all of the radionuclides that are expected to be in water; the analyst usually has a choice of methods and may emphasize either chemical separation or instrumental analysis, depending on inclination and laboratory equipment. Special problems in removing interfering substances and in detecting radionuclides at very low concentrations are encountered in measuring radionuclides in environmental water, but the procedures summarized in extensive compilations are usually applicable with appropriate modifications. Of special interest are the availability of relatively large Ge(Li) detectors for x and gamma spectrometry, and of liquid scintillation counters for detecting Cherenkov radiation from high energy beta particles. For the future, there is need to improve techniques for measuring radionuclides at very low concentrations, either by processing very large samples of water or by detecting radiation with greater sensitivity. Fundamental studies in the behavior of substances at very low concentrations in water would contribute valuable information on means of eliminating difficulties in sample preservation and analysis. The continued publication of standard procedures will lead to more consistent values and greater confidence in results. (auth)

2463 ANALYTICAL APPLICATIONS OF NEOTRIDECANOHYDROXAMIC ACID AS STATIONARY PHASE IN EXTRACTION CHROMATOGRAPHY. Site, A. D. (CNEN, Rome). J. Radioanal. Chem.; 14: No. 1, 45-51(Mar 1973).

Some analytical applications of neotridecanohydroxamic acid used as stationary phase in extraction chromatography columns are reported. Separations of Am–U–Th and Np–Pu are obtained in aqueous solutions and under different experimental conditions. The hydroxamic acid shows a peculiar selectivity for Np(IV) and Pu(IV) at pH = 0, and the two elements can be separated according to their respective valencies. A selective method for the determination of ^{237}Np and ^{238}Pu in urine is also described. The final recoveries are 73.5% for plutonium and 82.3% for neptunium, the decontamination factors and the sensitivity limits are suitable for the radiotoxicological detection of both elements. (auth)

Separation Procedures

2464 (CEA-CONF-2338) APPLICATIONS OF ION EXCHANGE RESINS IN THE SEPARATION OF TRANSURANIC ELEMENTS. Ganivet, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13–Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles). 1973. 8p. (In French). (CONF-730467-1). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting on the applications of ion exchange chromatography in chemical analysis; Paris, France (23 Apr 1973).

Separation of transuranic elements is made difficult by the great similarity between the chemical properties of these elements. Of the various methods available for this purpose, the ion exchange method is one of the most efficient. This technique can be used to quantitatively separate all the transuranic elements by utilizing factors such as complexation and oxidation–reduction. Some examples are given. (FR)

2465 (CONF-721010-90) SEPARATION OF CATIONS BY ISOTOPIC EXCHANGE USING METAL CHELATES AND FIXED METAL SULPHIDE PRECIPITATES. Banyai, E.; Gimesi, O.; Farkas, A. (Budapesti Muszaki Egyetem (Hungary)). 1972. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The possibilities of radioanalytical separation by isotopic exchange with metal chelate complexes and metal sulfide precipitates fixed on paper were examined for the following system: $^{203}Hg^{2+} + {}^{58}Co^{2+} + {}^{65}Zn^{2+} + {}^{24}Na^{+}$. (FR)

2466 (INIS-mf-360) CHEMISTRY OF ACTINIDE ELEMENTS: SOME ASPECTS OF THE SOLVENT EXTRACTION OF URANIUM(IV) AND URANIUM (VI). Pai, S. A. (Bombay Univ. (India)). 1970. 70p. INIS.

Thesis.

Studies on some aspects of solvent extraction of uranium(IV) and uranium(VI) are reported. The investigation is described in two parts. The first part deals with the determination of stability constants of nitrate and sulfate complexes of uranium(IV) by solvent extraction. Uranium(IV) was extracted from nitric and sulfuric acid solutions by 20% benzene solution of tributyl phosphate (TBP) and 0.1M thenoyltrifluoracetone (HTTA) in benzene at an ionic strength of 3.8 and an acidity of 1M. Uranium(IV) concentration in both the phases was estimated by a colorimetric method. Stability constants of both nitrate and sulfate complexes were calculated by various methods. For nitrate complexes, values of β obtained by TBP extraction were found to be very high compared to the values obtained by HTTA extraction data. For sulfate complexes, the values of β obtained by TBP extraction were in good agreement with reported values and values obtained by HTTA extraction were comparatively lower. The computed value of $\beta = 1.2$ for nitrate complex and $\beta_1 = 188$ and $\beta_2 = 7358$ for sulfate complexes by HTTA extraction seem to be more reliable than by TBP extraction because of the simplicity of the underlying assumption in the HTTA system. The second part of the study deals with the study of the effect of temperature and salt concentration on the synergetic extraction of uranyl ion with HTTA and neutral donors. Distribution ratios for the synergetic species $UO_2(TTA)_2S$ where S = TOPO, TBP, DBSO, and DPSO were determined at various temperatures from 30° to 70° at a pH = 1.6 in HCl medium. The equilibrium constant (K) for the formation of the species was evaluated from the distribution data at various temperatures. From a plot of log K vs. 1/T, ΔH values were calculated for all the systems. The results indicated that whereas TBP and sulfoxide complexes are enthalpy stabilized, both enthalpy and entropy contribute to the stability of $UO_2(TTA)_2$ TOPO. The effect of salt concentration in the aqueous phase on the extraction of the species $UO_2(TTA)_2S$ was studied by distribution measurement in the above system, in the presence of varying concentrations of the perchlorates of lithium, sodium, and ammonium. The distribution ratio was found to increase with salt concentration in the aqueous phase. The enhanced extraction in the presence of lithium perchlorate was correlated with its larger hydrated ionic radius. (INIS)

2467 PURIFICATION OF CERIUM USING CERIC AMMONIUM NITRATE. Ishii, E.; Miyake, Y. (Government Industrial Research Inst., Osaka). Osaka Kogyo Gijutsu Shikenjo Kiho; 24: No. 2, 93-98(Jun 1973). (In Japanese).

The following methods were investigated for the separation of lanthanides such as La, Pr, Nd, Sm, Eu, and Y in ceric ammonium nitrate: (1) fractional crystallization of ceric ammonium nitrate; (2) treatment of nitrocerite complex anion with cation exchanger; and (3) extraction of ceric ammonium nitrate using TBP as a solvent. Rare earth impurities were measured with the aid of radiotracer techniques. In the course of the first operation, the co-crystallization ratio of rare earth elements to cerium was 0.03 (La) to 0.06 (Eu). In the course of the second method, the distribution coefficients of Ln(III) were 10^5 to 400, varying as to concentration of solution. In the course of the third method, the ratio of extraction of La to Sm were 0.006 to 1.23%, and 99.9 to 98.5% of La to Sm in organic phase were stripped by 6N nitric acid. (auth)

2468 REVERSED-PHASE EXTRACTION CHROMATOGRAPHY OF THE RARE EARTHS, THORIUM, URANIUM, AND ZIRCONIUM WITH A HIGH-MOLECULAR-WEIGHT AMINE IN SULFURIC ACID AND AMMONIUM SULFATE MEDIA. Shimizu, T.; Ikeda, K. (Gunma Univ., Maebashi, Japan). J. Chromatogr.; 85: No. 1, 123-128(10 Oct 1973).

The column chromatographic behavior on silica gel impregnated with a high-molecular-weight amine, Amberlite LA-2 (SO_4^{2-}), of the trivalent rare earths and thorium(IV) in sulphuric acid and acid ammonium sulphate media was investigated. The distribution coefficients of these metal ions decrease with increasing concentration of the acid and sulphate, particularly in the acid system. The separation factor of thorium(IV) to the trivalent rare earths is large enough to separate two metals on the Amberlite LA-2 column in 0.025 M sulphuric acid –1.0 M ammonium sulphate solution. Thorium(IV), zirconium(IV), and uranium(VI) are adsorbed on the column in the same solution. Thorium(IV) is removed easily from the column by elution with 0.1 M sulphuric acid, while uranium(VI) and zirconium(IV) are strongly adsorbed. A separation procedure on the Amberlite LA-2-silica gel column was developed for the trivalent rare earths, thorium(IV), zirconium(IV), and uranium(VI), in which all four of the metal ions can be chromatographically separated by consecutive elution with sulphuric, hydrochloric and perchloric acids. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 4757.

Chemical and Physicochemical Properties

Refer also to abstracts 2555, 2561, 2562, 2988, 2997, 3334, 4732, 4748, and 4785.

2469 PROPERTIES OF CERIC OXIDE PREPARED BY THE THERMAL DECOMPOSITION OF CEROUS OXALATE. Ishii, E.; Miyake, Y. (Government Industrial Research Inst., Osaka). Osaka Kogyo Gijutsu Shikenjo Kiho; 24: No. 2, 99-103(Jun 1973). (In Japanese).

To make clear the properties of ceric oxide prepared by the decomposition of hydrated cerous oxalate, the following items have been investigated: (1) differential thermal and thermogravimetric analysis of hydrated cerous oxalate and (2) characterization of ceric oxide obtained on heating at several temperatures. Thermal decomposition products were characterized by x-ray powder diffraction, infrared absorption, density, surface area, and solubility in some acids. Hydrated cerous oxalate was decomposed to ceric oxide by heating at 257°C for about 2 hr, but the small amounts of carbonate and oxalate still remained. Temperature as high as 600°C was necessary to obtain complete ceric oxide. In general, the crystalline size of ceric oxide obtained increased with an increase in heating temperature and the color varied from pale yellow to slightly yellowish white. As the calcination temperature was increased the activity of ceric oxide decreased. (auth)

2470 KINETICS STUDY OF THE REACTION OF HO_2 WITH SO_2 AND NO. Payne, W. A.; Stief, L. J.; Davis, D. D. (Goddard Space Flight Center, Greenbelt, MD). J. Amer. Chem. Soc.; 95: No. 23, 7614-7619(14 Nov 1973).

Using the photochemical $^{18}O_2$ competitive isotope labeling technique, rate constants have been determined for reaction of the hydroperoxyl radical with the atmospheric gas SO_2. All measurements were made relative to the disproportionation reaction $HO_2 + HO_2 \rightarrow H_2O_2 + O_2$. At 300°K the rate constant for reaction of SO_2 with HO_2 was found to be $(8.7 \pm 1.8) \times 10^{-16}$ cm^3 molecule^{-1} sec^{-1}. The quoted uncertainty reflects the uncertainty in the measurement of the rate constant ratio $k_2/(k_7)^{1/2}$. Because of existing uncertainties in the value of k_7, however, the possible range of values in k_2 is 8.2×10^{-16} to 1.5×10^{-15} cm^3 molecule^{-1} sec^{-1}. Also using the photochemical $^{18}O_2$ competitive isotope labeling technique, it has been possible to estimate the value of the rate constant for reaction of HO_2 with NO. The rate constant for this system, k_3, was found to be 3×10^{-13} cm^3 molecule^{-1} sec^{-1} with the uncertainty in its value being a factor of ±3. The possible importance of secondary reactions in the determination of k_2 and k_3 is discussed. (auth)

Isotope Effects

Refer also to abstract 2527.

2471 ISOTOPE STUDIES OF THE ISOMERIZATION OF OLEFINS HOMOGENEOUSLY CATALYSED BY PALLADIUM, PLATINUM, AND RHODIUM COMPLEXES. Cruikshank, B. I.; Davies, N. R. (Univ. of New South Wales, Kensington, Australia). Aust. J. Chem.; 26: No. 9, 1935-1947(Sep 1973).

No entry of deuterium into olefin could be detected as a result of isomerization of allylbenzene in the presence of palladium(II) catalysts in CH_3CO_2D or CH_3OD. The deuterium isotope effect on the rate of isomerization was found to be high in the case of CH_3CO_2D, but slight in the case of CH_3OD. In the case of catalysis by rhodium complexes, entry of deuterium into olefin occurs in CH_3OD but not in CH_3CO_2D. Isotope effects parallel those observed with palladium(II). The isomerization of $PhCD_2CH_2CH = CH_2$ catalysed by palladium(II) results in a near-to-random distribution of deuterium throughout the side chain. The results are consistent with a hydrido-π-olefin complex mechanism of isomerization. Differences between catalysis by palladium(II) and rhodium(III) are discussed in terms of possible differences in the mechanism of formation of the active catalyst. In the case of palladium it is concluded that a relatively rapid rate of σ-π interchange and hence of double bond shift occurs within the equilibrium system of catalyst and olefin, and that exchange of olefin with the substrate constitutes the slower, rate-determining step. The behavior of platinum(II) is generally similar to that of palladium(II) but is only effective at higher temperatures. (auth)

2472 HYDROLYSIS OF DISUBSTITUTED ALKYL PHOSPHOROCHLORIDATES AND N,N,N′,N′-TETRA-SUBSTITUTED PHOSPHORODIAMIDIC CHLORIDES IN WATER AND DEUTERIUM OXIDE: HEAT CAPACITY OF ACTIVATION AND KINETIC SOLVENT ISOTOPE EFFECTS. Ko, E. C. F.; Robertson, R. E. (Univ. of Calgary, Alberta). Can. J. Chem.; 51: No. 4, 597-603(15 Feb 1972).

The pseudo-thermodynamic parameters, $\Delta H^\ddagger$, $\Delta S^\ddagger$, and $\Delta C_p{}^\ddagger$ and the kinetic solvent isotope effects were determined for the three alkyl-phosphorochloridates, where the alkyl group is ethyl isopropyl, and n-propyl; for tetramethyl- and tetraethyl-phosphorodiamidic chlorides; for the di-n-propyl and di-isopropyl analog, for the di(isopropylmethylcarbinyl)phosphorochloridate and for the tetraethylthiophosphorodiamidic chloride. These compounds have a potential relationship to compounds used as insecticides and as polymers. The mechanism of reaction is discussed on the basis of these data. (auth)

2473 ANHARMONICITY CORRECTION FOR KINETIC ISOTOPE EFFECT CALCULATIONS. Bron, J.; Hacker, S. O. (Univ. of Natal, Durban, S. Afr.). Can. J. Chem.; 51: No. 16, 2765-2768 (15 Aug 1973).

The kinetic isotope effect, in the ring opening of a triatomic system, is corrected for anharmonicity in the vibrational ground state. For this system it is found that the correction is small and not larger than uncertainties caused by other assumptions made in kinetic isotope effect calculations. (auth)

2474 COLLISIONAL DEACTIVATION OF THE $c^1\pi$ AND $A^3\pi$ STATES OF IMINO RADICALS. Kawasaki, M.; Hirata, Y.; Tanaka, I. (Tokyo Inst. of Tech.). J. Chem. Phys.; 59: No. 2, 648-653 (15 Jul 1973).

The photolysis of ammonia-d_0 and -d_3 was studied at each of the three wavelengths, Lyman-α (121.6 nm), Kr resonance lines (123.6, 116.5 nm), and Xe resonance lines (147.0, 129.6 nm). For Lyman-α, Kr resonance lines, and 129.6 nm, NH($c^1\pi$) emission was observed. In the Kr sensitization, both NH($c^1\pi$) and ($A^3\pi$) emissions were detected. In the direct photolysis, the effects of Xe, Kr, Ar, He, H_2, and N_2 as foreign gases were studied. Xe and Kr caused the intersystem crossing of NH and ND($c^1\pi \rightarrow A^3\pi$) to occur. Electronic quenching of NH or ND($c^1\pi$) was also observed for Xe, Kr, H_2, and N_2. The cross sections for intersystem crossing and quenching are presented. H_2, N_2, He, and Ar caused no intersystem crossing of NH and ND($c^1\pi$). Neither He nor Ar quenched the emission from NH and ND($c^1\pi$). (auth)

2475 DEUTERIUM ISOTOPE EFFECTS ON INITIAL RATES OF THE LIVER ALCOHOL DEHYDROGENASE REACTION. Bush, K.; Shiner, V. J. Jr.; Mahler, H. R. (Indiana Univ., Bloomington). Biochemistry; 12: No. 23, 4802-4805(6 Nov 1973).

Initial steady-state velocities using highly purified deuterated substrates and coenzymes as well as an isoenzymatically homogeneous enzyme preparation were measured for liver alcohol dehydrogenase at 25° in 20 mm phosphate (pH 7.0) or 20 mm pyrophosphate (pH 8.8). Significant isotope effects of $v_{s,H}/v_{s,D}$ were observed. In the reduction of acetaldehyde by A-NADD the isotope effects were found to decrease with increasing acetaldehyde concentration, a result consistent with an ordered Theorell–Chance mechanism for the reduction of acetaldehyde only at saturating substrate concentrations. No kinetically significant interactions were observed between the enzyme and the untransferred hydrogen of NADH. (auth)

2476 QUANTITATIVE BIPHOTONIC CHEMISTRY BY A FLUORESCENCE LOSS METHOD. The Photodissociation and Photoionization of Durene in a Rigid Solution. Schwarz, F. P.; Albrecht, A. C. (Cornell Univ., Ithaca, NY). J. Phys. Chem.; 77: No. 23, 2808-2822(8 Nov 1973).

Two simultaneous biphotonic chemistries in a rigid organic solution are treated quantitatively. The fractional ''fluorescence loss'' of the parent solute molecule is monitored as the key experimental parameter for quantifying the photochemistry. The fluorescence loss results both from the depletion of the parent molecule as well as competitive light absorption by the photoproducts. Furthermore the photoproducts are not homogeneously distributed in the sample because of its high viscosity. A general formalism is developed for handling this problem with the aim of obtaining quantum yields or cross sections for the several elementary steps. Durene as the solute in 3-methylpentane at 77°K is the example studied. Here the two photochemistries are β-bond scission to give the duryl radical, and a one-electron ionization to give the durene cation. Both photochemistries proceed via a one-photon excitation from the lowest durene triplet state. The two simultaneous photochemical channels are differentiated by reversing the ionization step through infrared-induced charge recombination and measuring a fractional "fluorescence recovery" of durene. Perdeuterated durene is studied as well. The β-bond cleavage shows a strong isotope effect. The quantitative results, though crude, yield the following results. The quantum yields for the second photon step at 275 nm out of the triplet state are ~0.4 (β-bond scission) and ~0.6 (ionization). Thus every excitation appears to lead to photochemistry. Molar decadic extinction coefficients at 270 nm in nonpolar solution at 77°K are found to be 1.3×10^4 for the triplet state, 2.5×10^3 for the duryl radical, and $\sim 0.5 \times 10^3$ for the durene cation. The efficiency for the infrared-induced charge recombination to generate durene via its excited singlet and triplet states is found to be of the order of unity. Finally, a previously discovered one-photon channel for the β-bond cleavage via upper vibrational levels of the first excited singlet state is seen to proceed with a quantum yield of $\sim 10^{-4}$. (auth)

2477 ESTIMATION OF KINETIC ISOTOPE EFFECTS USING ATOMIC FORCE CONSTANTS. King, W. T. (Brown Univ., Providence). J. Phys. Chem.; 77: No. 23, 2770-2779(8 Nov 1973).

Using atomic force constants, primary kinetic isotope effects in a series of well-studied reactions were computed by Bigeleisen's frequency moment method. It was found that the kinetic isotope ratios were predicted with sufficient accuracy to discriminate between alternative mechanisms for the same reaction. The application of atomic force constants to the analysis of secondary isotope effects is also briefly considered. (auth)

2478 NEW EXPLANATION OF THE INFRARED AND RAMAN UPSILON(XH) BAND SHAPE OF HYDROGEN-BONDED COMPLEXES. Lascombe, J.; Lassegues, J. C.; Huong, P. V. (Univ., Bordeaux). J. Phys. Chem.; 77: No. 23, 2779-2782(8 Nov 1973).

A theory is proposed to explain the width of the infrared and Raman ν(XH) stretching band of gaseous hydrogen-bonded complexes X–H ... Y and to predict the effects of isotopic substitution and temperature. The calculated profiles of the FH ... $NCCH_3$ and FD ... $NCCH_3$ complexes are then compared with the experimental spectra. The model is extended to interpret the ν(XH) bandwidth of hydrogen bonds in the condensed state. (auth)

2479 PHOTOISOMERIZATIONS OF 2-METHYLPHENYLCYCLOPROPANES. Isotope Effects and Stereochemistry. Mazzocchi, P. H.; Lustig, R. S. (Univ. of Maryland, College Park). J. Org. Chem.; 38: No. 23, 4091-4092(16 Nov 1973).

A deuterium-labeling study on 2,2-dimethylphenylcyclopropane has resulted in the determination of secondary and rather small primary isotope effects for the photochemical reaction and has shown that hydrogen migration in this system takes place preferentially from the methyl group trans to the benzene ring. (auth)

2480 CHARACTERIZATION OF THE THERMAL DEHYDRATION OF ZIRCONIUM OXIDE HALIDE OCTAHYDRATES. Powers, D. A.; Gray, H. B. (California Inst. of Tech., Pasadena). Inorg. Chem.; 12: No. 11, 2721-2726(Nov 1973).

The compounds $ZrOX_2 \cdot 8H_2O$ (X = Cl, Br) dehydrate thermally in a stepwise manner to the respective hexahydrates, tetrahydrates, and finally ZrO_2. Dehydration is complete at 700°. The intermediate hydrates were isolated and characterized. Several regions of the infrared spectra of the various hydrates were assigned with the aid of analogous deuterated compounds. The experimental evidence may be interpreted in terms of the structural formulations $[Zr_4(OH)_8(H_2O)_{16}]X_8 \cdot 12H_2O$, $[Zr_4(OH)_8(H_2O)_{16}]X_8 \cdot 4H_2O$, and $[Zr_4(OH)_8(H_2O)_{12}]X_8$, for the octahydrates, hexahydrates, and tetrahydrates, respectively. The last tetrameric cation is proposed to contain seven-coordinate Zr(IV). (auth)

2481 NUCLEOPHILIC SUBSTITUTION ON NITROGEN. Kinetics of Reactions of Hydroxylamine-O-Sulfonate Ion. Krueger, J. H.; Blanchet, P. F.; Lee, A. P.; Sudbury, B. A. (Oregon State Univ., Corvallis). Inorg. Chem.; 12: No. 11, 2714-2718 (Nov 1973).

Kinetics of the reactions of hydroxylamine-O-sulfonate ion, $H_2NOSO_3^-$, with the nucleophiles I^-, $(C_6H_5)_3P$, and $(C_2H_5)_3N$ were measured in water and in 50 wt % methanol–water. For each reaction a rate law of the type $-d[H_2NOSO_3^-]/dt = k_2[H_2NOSO_3^-][Nu]$ was observed. The mechanism proposed for each system involves nucleophilic substitution on the nitrogen atom, with SO_4^{2-} as the leaving group. The order of nucleophilicities observed is $(C_6H_5)_3P > I^- > (C_2H_5)_3N \gg Br^-, Cl^-$. A significant result is the decrease in reactivity of $H_2NOSO_3^-$ upon protonation of the nitrogen lone pair to form molecular H_3NOSO_3. Deuterium isotope effects observed for reaction of $H_2NOSO_3^-$, compared with $D_2NOSO_3^-$ in D_2O, are $k_H/k_D = 1.5$ for $(C_6H_5)_3P$ and 1.3 for I^-. Replacement of H by CH_3 or $C_6H_5C(O)$ greatly decreases reactivity, suggesting a large steric influence in the transition state. (auth)

2482 ISOTOPE EFFECTS IN THE SOLVOLYSIS OF HALOALLENES. Schiavelli, M. D.; Ellis, D. E. (Coll. of William and Mary, Williamsburg, VA). J. Amer. Chem. Soc.; 95: No. 23, 7916-7917(14 Nov 1973).

Behavior of tri- and disubstituted haloallenes under solvolytic conditions was studied. Alpha- and beta-secondary isotope effects were measured. Experimental data support a carbonium ion mechanism. (LK)

2483 SECONDARY DEUTERIUM ISOTOPE EFFECTS IN SOLVOLYSIS OF CYCLOPENTYL P-BROMOBENZENESULFONATE. Stereochemistry of E1 and Sn1 Reactions. Humski, K.; Sendijarevic, V.; Shiner, V. J. Jr. (Rudjer Boskovic Inst., Zagreb). J. Amer. Chem. Soc.; 95: No. 23, 7722-7728(14 Nov 1973).

Secondary α- and β-isotope effects in solvolysis of cyclopentyl-1-d, cis-cyclopentyl-2-d, trans-cyclopentyl-2-d, and cyclopentyl-2,2,5,5-d_4 brosylates were measured in different ethanol–water (E–W) and trifluoroethanol–water (TFE–W) mixtures. The magnitude of the effects indicates that in the E–W mixtures the products are derived by rate-determining substitution and elimination on the reversibly formed intimate ion pair. However, the change to TFE–W mixtures causes a change in mechanism; in these solvents the formation of the solvent separated ion pair is rate determining and the products are formed in fast subsequent attack on this intermediate. Consistent with this interpretation of the isotope effects, the elimination in E–W mixtures was found to be stereospecifically trans, while in TFE–W mixtures it is nonstereospecific. It was also determined that the configuration of the cyclopentanol formed in both types of solvents was inverted in comparison to the starting material. A detailed analysis provides an estimation of the isotope effects in each of the individual steps in the reaction. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 2465.

2484 (CEA-R-4479) ISOTOPIC EXCHANGE BETWEEN HYDROGEN AND LIQUID HYDROCARBONS CATALYZED BY ORGANOALKALI COMPOUNDS. Baffert-Forges, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). Oct 1973. 84p. (In French). Dep. NTIS (U. S. Sales Only) $6.25.

Toluene, diphenylmethane, and triphenylmethane, in the presence of their respective organoalkali derivatives, give rise to an isotopic exchange in liquid phase with molecular hydrogen. This exchange does not occur with pentane, methane, benzene, and 1-hexyne. The possibility of isotopic exchange seems to be limited to a narrow range of pKa going from 32 to 35 in the MSAD scale, and inside this range, the exchange rate increases with the pKa value. The solubility of hydrogen in diphenylmethane was measured. Between 30 and 180°C, it increases linearly, and may be represented by the following equation, where θ is the temperature in °C: $\sigma_{cm^3/cm^3/atm} = 2.64\ 10^{-4}\ \theta + 0.026$. The exchange between hydrogen and diphenylmethylpotassium was studied between 120 and 180°C. Results show that: 1) the exchange rate is first order with respect to the concentration of dissolved hydrogen, and also with respect to the overall diphenylmethylpotassium concentration; 2) the catalytic species are probably the contact ion pairs $(C_6H_5)_2\ CH\theta\ \theta K$. The value of the activation energy is 21 Kcal mole^{-1}, and the activation entropy was found equal to 1.5 E. U. An associative reaction mechanism is proposed, in agreement with the weakly positive value of the activation entropy. A theoretical calculation of the kinetic isotope effect between the passage rate of deuterium and of tritium from hydrogen to the hydrocarbon carried out on the proposed activated complex model is in agreement with our experimental value. (auth)

2485 METHOD TO PRODUCE META- AND PARA-IODOBENZOIC ACIDS LABELLED WITH IODINE ISOTOPES. Iroshnikova, N. G.; Klimova, T. P.; Stanko, V. I. (Inst. of Biophysics, Moscow). Isotopenpraxis; 9: No. 2, 50-54(Feb 1973). (In Russian).

The isotopic exchange reactions between sodium iodide and meta-(para-)iodobenzoic acids were shown to take place in solvating solvents (water, alcohols, dioxane, tetrahydrofurane, acetonitrile) only in the presence of the transient metal salts, the yield of labelled compounds being high. The possible mechanism of the reaction is suggested. The ir- and EGR-spectroscopies were used to identify the meta- and para-iodobenzoic acids. (auth)

2486 CONTINUOUS ISOTOPIC EXCHANGE COLUMN FOR HYDROGEN–WATER OR HYDROGEN–AMMONIA. Hodor, I.; Peculea, M.; Straulea, R. S. (Inst. for Stable Isotopes, Cluj). Isotopenpraxis; 9: No. 1, 6-10(Jan 1973).

A continuous isotopic exchange column for hydrogen–water or hydrogen–ammonia systems is described and studied experimentally. Two transfer coefficients, k_s and k_d, characterize the quality of exchange space and these coefficients were determined in different conditions of temperature and pressure. (auth)

2487 EXTRACTION OF DEUTERIUM FROM AMMONIA SYNTHESIS GAS. Rae, H. K. (to Atomic Energy of Canada Ltd.). Canadian Patent 909,483. 12 Sep 1972. vp.

A process for extraction of deuterium from ammonia synthesis gas by means of an ion-exchange fluid, typically ammonia containing potassium oxide catalyst, is described. The exchange medium is enriched in deuterium by countercurrent contact first with ammonia synthesis gas at –40°C and then with a stream of hydrogen in second and third cold regions. After it leaves the first cold region, the exchange medium is stripped of dissolved nitrogen. Hydrogen gas from the second cold region is recycled to a hot region where it is enriched in deuterium at the expense of ammonia from the third cold region. Ammonia from the hot zone is recycled to the first cold region. The deuterium content of both the hydrogen and the exchange medium is a maximum between the hot zone and the last cold region and either or both of these streams may be withdrawn at this point for further enrichment or deuterium extraction. The process requires that only one of the exchange regions be large enough in size to accommodate nitrogen of the ammonia synthesis gas. (CA)

2488 BASE-CATALYZED HYDROGEN–DEUTERIUM EXCHANGE REACTIONS OF LONG-CHAIN ALKYLDIMETHYLSULFONIUM HALIDES. Yano, Y.; Okonogi, T.; Tagaki, W. (Gunma Univ., Japan). J. Org. Chem.; 38: No. 22, 3912-3915(2 Nov 1973).

Base-catalyzed H–D exchange reaction of sulfonium halides, $n\text{-}C_nH_{2n+1}S(CH_3)_2^+X^-$ (n = 1–12), has been studied by NMR technique. The rates of exchange of longer alkyl chain compounds (n = 10, 12) were found to be much larger than those of shorter chain compounds (n = 1–8). Under micellar conditions, the rates for lauryldimethylsulfonium salts (n = 12, X = Cl, Br, I) followed Michaelis–Menten type saturation kinetics with respect to hydroxide ion concentration, and they increase in the order of X = I < Br < Cl. (auth)

2489 EXCHANGE REACTIONS OF BENZENE ON A FUEL CELL ELECTRODE AT CATHODIC POTENTIALS. Barger, H. J. Jr.; Coleman, A. J. (Army Mobility Equipment Research and Development Center, Fort Belvoir, VA). J. Phys. Chem.; 77: No. 23, 2783-2786(8 Nov 1973).

The electrochemical reactions of C_6H_6 in D_3PO_4 were studied at electrode potentials ranging from 0.15 to –0.10 V measured against the dynamic hydrogen electrode. The effects of flow rate and reaction temperature were examined. Results indicated that the adsorption potential was important in determining the amount of reduction and that flow rate has a marked effect on the isotopic distribution of benzene and cyclohexane. Readsorption of product cyclohexane was shown to occur but was not a major factor in determining isotopic distributions. The relative amount of deuteriocyclohexanes produced using C_6H_{12} as the reactant suggested two types of exchange reactions were occurring. (auth)

2490 KINETIC AND THERMODYNAMIC STUDIES ON A LABILE TRANS-DINITROCOBALT(III) COMPLEX. Goff, H.; Kidwell, S.; Lauher, J.; Murmann, R. K. (Univ. of Missouri, Columbia). Inorg. Chem.; 12: No. 11, 2631-2640(Nov 1973).

Cobalt(III) complexes of an α-amine oxime trans-[Co(PnAO-H)X_2]^0 were prepared where X is one of the following ligands: NO_2^-, N_3^-, Cl^-, or OH_2. The trans ligands are relatively labile to substitution even in nearly neutral aqueous media. Replacement of a coordinated NO_2^- group by N_3^- or the reverse follows the path $Co-NO_2 \rightleftharpoons Co-OH_2 \rightleftharpoons Co-N_3$. The forward rate is controlled by the replacement of NO_2^- by H_2O which follows the rate law rate = $k[Co-NO_2] + k'[Co-NO_2][OH^-]$. The same law and constants are obtained for the $^{15}NO_2^-$ exchange with the trans-dinitro complex. Equilibrium constants are reported for NO_2^-–N_3 competition for the trans coordination positions and for NO_2^-, Cl^-, and N_3^- competition with H_2O. Using isotopic rates of exchange studies it is shown that in the trans complexes (dinitro, diazido, dichloro), the axial ligands are not equivalent and substitute with rates differing by factors of 15 to 50. Isotopic NO_2^- exchange rate studies on other more common trans-dinitro complexes are compared in an effort to distinguish between steric and electronic effects as the cause of the nonequivalence of the axial ligands. The solution results are compared with the crystal structure of [Co(PnAO–H)$(NO_2)_2$]^0 concurrently presented. (auth)

2491 ISOTOPE EXCHANGE AND ADSORPTION IN THE SYSTEM $Na_2[SiO_2(OH)_2] \cdot 4H_2O$, EQUILIBRIUM SOLUTION. Babayan, S. G.; Arutyunyan, A. M.; Balayan, M. A. (Erevan Lab. of Inorganic Solvents). Arm. Khim. Zh.; 24: No. 4, 274-282(1973). (In Russian).

Isotope exchange of Na between the equilibrium alkali-siliceous solution and stabilized crystals $Na_2[SiO_2(OH)_2] \cdot 4H_2O$ was studied. It has been shown that the isotope exchange of Na takes place along the solid phase. The distribution of Ca and Fe between the equilibrium solution and the solid phase was studied. (auth)

2492 EVIDENCE FOR CARBANIONIC INTERMEDIATES DURING EXCHANGE BETWEEN BUTANES AND DEUTERIUM ON ALUMINA. Robertson, P. J.; Scurrell, M. S.; Kemball, C. (Univ. of Edinburgh). J. Chem. Soc., Chem. Commun.; No. 20, 799(24 Oct 1973).

Examination of the exchange reactions between isobutane and deuterium, and n-butane and deuterium on alumina has revealed that the reactive hydrocarbon intermediates possess carbanionic character. (auth)

Feed Materials Processing

2493 (AAEC/TM-599) INVESTIGATION OF BATCH-TRAY CALCINATION-REDUCTION OF AMMONIUM DIURANATE TO URANIUM DIOXIDE. Alfredson, P. G.; Janov, J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1971. 26p. Dep. NTIS (U.S. Sales Only) $3.50.

Process cycles were developed on the half-kilogram scale for the conversion of ADU to UO_2 powder of specified surface area in the range 3-10 m^2/g. The recommended cycle involves calcination of ADU in nitrogen during heating to the reduction temperature, followed by reaction with 30 vol %, hydrogen in nitrogen and stabilization at ambient temperature with 2 vol % oxygen in nitrogen. UO_2 surface area increased from 3 to 10 m^2/g as the reduction temperature changed from 700 to 500°C, but was not sensitive to the surface area of the precursor ADU or the hydrogen flow rate. 11 figures, 26 references. (auth)

2494 (IEA-277) PILOT PLANT FOR PURIFICATION OF URANIUM BY THE PULSED COLUMN PROCESS IN OPERATION AT THE INSTITUTE OF ATOMIC ENERGY. Franca, J. M. Jr. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Oct 1972. 136p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $9.00.

A description of the uranium purification process, which has been used in a pilot plant at the Chemical Engineering Department of the Atomic Energy Institute in S. Paulo, Brazil, is given. Details are presented of the following steps: (a) dissolution and digestion of the uranium concentrate (yellow cake) for the preparation of uranyl nitrate; (b) the 3 columns operation involving extraction, scrubbing, and stripping; (c) the pure ammonium diuranate preparation, as a final product obtained at the pilot plant by continuous and discontinuous process; (d) the organic phase in the stripping column outlet; (e) uranium recovery from both aqueous effluents and the suspended particles in the air from the weighing area; and (f) estimated cost for the final product. (auth)

Radiation Chemistry

Refer also to abstracts 2544, 2701, 2831, 2857, 3123, 3135, 3678, 4525, and 4760.

2495 (COO-958-40) PROPERTIES OF SOLVATED ELECTRONS AND ASSOCIATED SPECIES IN METAL SOLUTIONS AND KINETICS OF ELECTRON- AND PROTON-TRANSFER REACTIONS. Progress Report, September 16, 1972–September 15, 1973. Dye, J. L. (Michigan State Univ., East Lansing (USA). Dept. of Chemistry). 1973. Contract AT(11-1)-958. 30p. Dep. NTIS $3.50.

A macrobicyclic polyoxa diamine for "cryptate" formation with alkali cations was synthesized and used to extend optical, ESR, and pulse radiolysis studies of e^-_{solv}, M, and M^- in amines and ethers. The rate of complexation of Na^+ to form the cryptate was studied by ^{23}Na NMR techniques. An ESR study of metal–ammonia solutions showed that electron spin-pairing is virtually independent of the cation used over the range studied (0.02 to 0.1M and –60 to 0°C). The properties of a new crystalline solid formed from solutions of sodium in ethylamine in the presence of "crypt" strongly suggest that it is a salt of the complexed sodium cation,

NaC^+ and the sodium anion, Na^-. Although the crystals show specular reflection, which resembles metallic gold, the conductivity of bulk powdered samples is low with a temperature dependence similar to that of a semi-conductor. A computerized rapid-scan stopped-flow system was constructed, tested, and used for study of reactions of metal solutions. A study of the kinetics of protonation of the anthracenide radical anion was completed and interpreted on the basis of dianion, ion-pair, and ion-cluster formation. (auth)

2496 (COO-1054-64) ELECTRON PARAMAGNETIC RESONANCE STUDIES OF RADIATION EFFECTS IN SOLIDS AND CHEMICAL COMPOUNDS. Final Report. Kim, Y. W. (Wayne State Univ., Detroit, Mich. (USA). Dept. of Physics). 5 Nov 1973. Contract AT(11-1)-1054. 21p. Dep. NTIS $3.25.

Research from June 15, 1961 through September 15, 1973 is summarized in the following fields: (1) chemical compounds ($DPPH_2$ and its radical DPPH), (2) nonmetallic materials (alkali metal halides, Al_2O_3, and Li_2SO_4 with or without transition-metal ions), and (3) normal and superconducting metals. (63 references) (DLC)

2497 (INIS-mf-706) RADIATION EFFECTS ON ORGANIC COMPOUNDS. Rajeshwari, A. R. (Bombay Univ. (India)). 1972. 96p. INIS.

Thesis.

Radiation effects on some organic compounds were studied. The study consists of two parts. In the first part, the effects of γ radiation on sulfanilic acid in aqueous solutions were investigated. In the presence of radiation, water radiolyses to give hydrogen atoms and hydrated electrons as transient reducing species and hydroxyl radicals as transient oxidizing species. These species rapidly react with sulfanilic acid in aqueous solutions. Rate constants of these reactions therefore provide a convenient measure of radiation effects on sulfanilic acid in aqueous solutions. An aqueous solution of sulfalinic acid was irradiated with γ rays (at a dose of $\sim 10^{20}$ eV) from a ^{60}Co source. Isopropanol was used as a competitor for rate constant measurements. Hydrated electrons were produced by the photolytic reaction of OH^- in a solution of NaOH saturated with hydrogen. Methods employed for preparation of the aqueous solutions, degassing, dosimetry, and determination of rate constants are described in detail. The rate constants of the sulfanilic acid reactions were found to be $2.75 \times 10^{-8}\ M^{-1}\ sec^{-1}$, $1.2 \times 10^{9}\ M^{-1}\ sec^{-1}$, and $2.54 \times 10^{8}\ M^{-1}\ sec^{-1}$ for H atoms, OH radicals, and e^-_{aq} respectively. The reaction kinetics of sulfanilic acid with the transient species generated in aqueous solutions is significant in the study of biological systems subjected to radiotherapy after administration of sulfa drugs. In the second part of the study, some synthetic reactions induced by 150 kV x radiation are investigated. As an example of the radioinduced addition to the double bond, addition of hydrochloric acid to cyclohexane for synthesizing chlorocyclohexane was studied. As an example of the radioinduced substitution reaction, paraffin wax in CCl_4 was chlorinated by passing gaseous chlorine through the solution. In both the cases, radioinduced processes give significantly high yields to warrant their consideration for use on an industrial scale. (INIS)

2498 (JINR-P14-7212) CONNECTION OF NEGATIVE MUON DEPOLARIZATION WITH RADIATION STABILITY OF SUBSTANCES. Dzhuraev, A. A.; Evseev, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 14p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Correlation was observed between the residual polarization of negative muons in a substance and the radiation stability of this substance. It was found that the observed correlation is well explained by the formal theory based on the concept about the fast chemical reactions of mesoradicals with environment. The speed at which the mesoradical is involved in chemical reactions in different hydrocarbons was determined. (auth)

2499 (LBL-2128) SOLID-STATE CHEMISTRY OF IRRADIATED CHOLINE CHLORIDE. Agarwal, R. D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1973. Contract W-7405-eng-48. 145p. Dep. NTIS $9.25.

Thesis.

The remarkable and unique sensitivity of crystalline choline chloride towards ionizing radiation was investigated. ESR studies at −196°C indicate the presence of a biradical, $(CH_3)_3\overset{+}{N}\cdot\cdot$ CH_2CH_2OH ---- Cl^-, that diffuses apart with rising temperature. These studies also indicate the presence of an ethanol monoradical. Thermoluminescence studies indicate that during γ irradiation electrons get trapped on crystal imperfections. These electrons are released upon warming above room temperature. It was also found that (1) the radiolysis can be induced at low temperature by transferring electrons from photodonors; (2) the radical decay is enhanced in the presence of photodonated electrons; (3) the radiolysis is retarded by the electron-accepting ambients; (4) the radiolysis is also retarded by doping the crystals with KI; (5) heating at 150°C before irradiation leads to diminished radiolysis; (6) large, slowly grown crystals are more resistant to radiolysis than are microcrystallites; (7) the extent of decomposition is increased for a given radiation dose if the dose delivery is interrupted by periods of heating at 50°; (8) the radical decay is faster than the radiolysis; (9) the radiolysis can be enhanced by exposure to thermal electrons. (auth)

2500 (ORO-3781-10) INVESTIGATION OF GAMMA-RAY INDUCED POLYMER FORMATION OF THE CARBORANES. Annual Progress Report, November 1, 1972–September 30, 1973. Klingen, T. J. (Mississippi Univ., University (USA). Dept. of Chemistry). 1 Oct 1973. Contract AT(40-1)-3781. 81p. Dep. NTIS $6.25.

Research is reported on the radiation chemistry of o-carborane [1, 2-dicarba-closo-dodecaborane (11)] and its 1-alkyl and 1-alkenyl derivatives. The principal purpose of the research is to establish optimum conditions for radiation-induced polymerization of such compounds. Properties and structures of polymeric products, identities and yields of minor products, and reaction mechanisms are being determined. (auth)

2501 (RRL-3238-457) QUARTERLY REPORT, JULY 1, 1973–SEPTEMBER 30, 1973. (Mellon Inst., Pittsburgh, Pa. (USA). Radiation Research Labs.). 5 Oct 1973. Contract AT(11-1)-3238. 22p. Dep. NTIS $3.25.

Research progress on various radiation chemistry studies continued or completed during the quarter is reported. Abstracts of papers submitted for journal publication or conference presentation are included. Résumés of investigations in progress are given. (JGB)

2502 (RRL-3238-458) ANNUAL REPORT, OCTOBER 1, 1972–SEPTEMBER 30, 1973. (Mellon Inst., Pittsburgh, Pa. (USA). Radiation Research Labs.). 15 Oct 1973. Contract AT(11-1)-3238. 28p. Dep. NTIS $3.50.

Research progress is reported on in situ radiolysis, which continues to be used for a variety of studies on radicals. Radiolysis studies were supplemented by studies on radicals produced in photochemical processes, including the photolysis of sulfite ions or persulfate ions in aqueous solutions. Time-resolved ESR studies are continuing. The pulse radiolysis apparatus, which is now completely interfaced with a PDP-8 computer, has been used to give insight into radiation chemical processes on the microsecond time scale. Pulse radiolysis techniques were used to study micellar effects in the radiation chemistry of benzophenone, methyl substituted quinones, and cholic acid derivatives. Development work continues on liquid chromatographic methods, which are suitable for analyzing irradiated systems, and ionic processes in hydrocarbon radiolysis. Studies of micellar effects on excited states of aromatic hydrocarbons have been carried out using fluorescence lifetime measurements. A list of journal publications and conference papers that give details on research during the year is included. (JGB)

2503 PULSE RADIOLYSIS OF NITRIC OXIDE IN AQUEOUS SOLUTION. Seddon, W. A.; Fletcher, J. W.; Sopchysyn, F. C. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Chem.; 51: No. 7, 1123-1130(1 Apr 1973).

Transient spectra observed on the pulse radiolysis of aqueous solutions of nitric oxide at pH 7.0 with high-energy electrons were assigned to the species NO^-, $N_2O_2^-$. In acid solution these species are protonated to form the corresponding acids, HNO, HN_2O_2, and HN_3O_3. Both the basic and acid forms undergo similar reactions but at different rates to form the products of radiolysis N_2O and NO_2^-: $N_3O_3^- \rightarrow N_2O + NO_2^-$; $HN_3O_3 \rightarrow N_2O + HNO_2$. The basic species decays more slowly than the corresponding acid species but both processes have appreciable activation energies of 15 and 10 kcals/mol, respectively. Computer calculations have been used in conjunction with the experimental data over a wide range of pH and NO concentration to deduce a reaction mechanism consistent with the observed results. Reaction rate constants, acid dissociation constants and extinction coefficients for the various species are presented and compared with earlier work. (auth)

2504 RADIATION-INDUCED HYDROGEN PEROXIDE FORMATION IN AIR-CONTAINING GLUTATHIONE SOLUTIONS. Proesch, U.; Haehn, J.; Siegel, G. (Humboldt Univ., Berlin). Isotopenpraxis; 9: No. 2, 63-68(Feb 1973). (In German).

The radiolysis of air-containing aqueous solutions of glutathione was investigated with 200 kV x rays at a pH of 3.5 to 3.9. The yields of glutathione consumption and hydrogen peroxide formation were measured. In the pH-region mentioned no remarkable chain was found. The radiolysis of 5×10^{-5} to 2.5×10^{-3} molar glutathione solutions may be interpreted by a competition of the reducing species from water radiolysis for glutathione and oxygen followed by further oxidation steps with RSO_2 and RSOOH as intermediates. (auth)

2505 RADIOLYSIS FREE ION YIELDS AND ELECTRON RANGES IN POLAR AND NONPOLAR LIQUIDS: FLUOROMETHANES. Robinson, M. G.; Freeman, G. R. (Univ. of Alberta, Edmonton). Can. J. Chem.; 51: No. 7, 1010-1015(1 Apr 1973).

Pulsed x radiolysis of liquid CH_3F, CH_2F_2, CHF_3, and CF_4 was studied at temperatures of 143 or 183°K. From conductivity measurements, free ion yields and ranges of secondary electrons were deduced. Free ion yields were found to increase in the order $CF_4 \ll CHF_3 < CH_3F < CH_2F_2$, being correlated with the dielectric constant. The variation of n, the average number of collisions needed to thermalize a secondary electron, with molecular structure, is discussed for a number of liquids. It was found that n decreased with increasing molecular complexity, with elongation of the molecule, polarity, and hydrogen bonding. (CA)

2506 REACTION OF THE HYDRATED ELECTRON WITH HS^-. Eager, R. L.; Kabachia, V.; Waltz, W. L.; Woods, R. J.; McCallum, K. J. (Univ. of Saskatchewan, Regina). Can. J. Chem.; 51: No. 12, 1920-1922(15 Jun 1973).

Evidence is presented to show that the hydrated electron reacts with monohydrogen sulfide ion with a rate constant of $(3.0 \pm 0.4) \times 10^7\ M^{-1}\ s^{-1}$ in contrast to an earlier report that this substrate was unreactive. A comparison of the electron reactivity towards hydrogen sulfides and selenides suggests that the reactivity reflects the ability of the substrate to accommodate the electron as opposed to its ability to donate a proton to the electron. (auth)

2507 EFFECT OF DOSE ON THE YIELD OF TRAPPED ELECTRONS IN ALIPHATIC AMINE GLASSES. Ito, T.; Noda, S.; Fueki, K.; Kuri, Z. (Nagoya Univ., Japan). Can. J. Chem.; 51: No. 16, 2801-2804(15 Aug 1973).

An electron spin resonance (ESR) and photoconductivity study was made of the effect of dose on the yield of trapped electrons in γ-irradiated aliphatic amine glasses at 77°K. It is shown that the effect of dose on the trapped electron yield can be correlated with matrix polarity. (auth)

2508 PULSE RADIOLYSIS OF DIMETHYLSULFOXIDE AND BINARY MIXTURES WITH WATER. Cooper, T. K. (Univ. of British Columbia, Vancouver); Walker, D. C.; Gillis, H. A.; Klassen, N. V. Can. J. Chem.; 51: No. 13, 2195-2206(1 Jul 1973).

The simultaneous interaction of solvated electrons with strongly solvating water molecules and weakly solvating dimethyl sulfoxide (DMSO) molecules was studied by pulse radiolysis. In all DMSO/H_2O mixtures investigated the solvated electrons have a single absorption band with a maximum intermediate between that of pure DMSO ($\lambda(max) > 1500$ nm) and that of water ($\lambda(max) = 720$ nm). There is a nearly linear relationship between the photon energy of $\lambda(max)$ and the bulk dielectric constant, indicating that the optical properties of solvated electrons in the mixtures are not dominated by the water. A minimum is observed in the variation of $G\epsilon(max)$ with DMSO/H_2O composition which may be associated with intermolecular structure. In mixtures containing > 0.2 mole fraction DMSO the solvated electrons have half lives of 11-18 ns. The radiation produced oxidizing species in DMSO has a half-life of 1-4 μs and an absorption band centered at 600 nm. This species seems to be present in all DMSO/H_2O mixtures. Pure DMSO gives a free-ion yield in the range 1.2 to 1.8, as determined separately for the oxidizing and reducing species by bromide and anthracene scavenging experiments respectively. This free-ion yield is in keeping with the dielectric constant of DMSO of 46. The yields in fully deuterated DMSO are ~30% higher than in the protonated material. (auth)

2509 OXIDATION OF SOME TRANSITION-METAL CYANIDE COMPOUNDS BY HYDROXYL RADICAL. Waltz, W. L.; Akhtar, S. S.; Eager, R. L. (Univ. of Saskatchewan, Saskatoon). Can. J. Chem.; 51: No. 15, 2525-2529(1 Aug 1973).

The oxidation of some transition-metal cyanide compounds by hydroxyl radical in aqueous media was investigated by pulse radiolysis. For compounds of the type, $M(CN)_6^{4-}$ where M is Fe, Ru, and Os, and for $Mo(CN)_8^{4-}$, the mechanism of their reaction with hydroxyl radical involves single electron transfer with the formation of the intensely colored metal complexes of the same stoichiometry as the starting materials. The uv-visible absorption spectra for these products for the iron, ruthenium, and osmium systems are reported along with the associated second order rate constants for their formation. The reaction of $Mo(CN)_8^{4-}$ with hydroxyl radical was studied by a competition technique using sodium bicarbonate. The values of the second order rate constants are near those expected of diffusion-controlled reactions and they range between ca. 5×10^9 to $1 \times 10^{10}\ M^{-1}\ S^{-1}$. (auth)

2510 EFFECT OF PRESSURE ON THE RATES OF REACTION OF HYDROGEN ATOMS IN THE RADIOLYSIS OF LIQUID ETHANOL. Jha, K. N.; Freeman, G. R. (Univ. of Alberta, Edmonton). Can. J. Chem.; 51: No. 12, 2033-2040(15 Jun 1973).

Under conditions of gamma radiolysis, competition between the reactions $H + C_2H_5OH \rightarrow H_2 + CH_3CHOH$ and $H + S \rightarrow HS$ (S = scavenger) was measured at 296°K at 1 bar and 5.4 kbar. Values of k_5/k_3 at 1 bar and $(\Delta V_5^{\ddagger} - \Delta V_3^{\ddagger})$ averaged between 1 bar and 5.4 kbar for several solutes S are: cyclohexene, 56, +2.7 cm^3/mol; hexene-1, 71, +2.6 cm^3/mol; phenol, 25, −3.8 cm^3/mol; benzene, 12, −6.5 cm^3/mol. The volume of activation of hydrogen atom addition to the aromatic ring is about 8 cm^3/mol more negative than that of addition to a mono-olefin. Rate constants of reaction of solvated electrons with these solutes at 295°K, measured by the pulse-radiolysis spectroscopy technique, are $(M^{-1}s^{-1})$: cyclohexene, $<1 \times 10^4$; hexene-1, 1×10^5; benzene, 4×10^6; phenol, 5×10^7. The phenol reaction with e^-_{solv} does not reduce the hydrogen yield by a proportionate amount, so phenol "catalyses" the decomposition of e^-_{solv} to form hydrogen. The scavenging of hydrogen precursors by 1-hexene, benzene, and aniline in n-hexane may be attributed to hydrogen atom reactions. The yields of hydrogen from solutions of neohexane in cyclopentane at 1 bar and 5.4 kbar indicate that charge transfer occurs from cyclopentane to neohexane, and that the probability of charge transfer is independent of pressure. The methane yields from these solutions indicate that the decomposition of the neohexane ion formed by charge transfer from cyclopentane, to form methane, is inhibited by pressure. (CA)

2511 TRANSIENT ION PAIRS FROM OH-RADICAL REACTIONS: PULSE RADIOLYSIS OF AQUEOUS ALKYL IODIDE SOLUTIONS. Bruehlmann, U.; Buechler, H.; Marchetti, F.; Buehler, R. E. (Swiss Federal Inst. of Tech., Zurich). Chem. Phys. Lett.; 21: No. 2, 412-414(15 Aug 1973).

Pulse radiolysis studies of aqueous alkyl iodide solutions reveal the existence of the transient ion pair $(HOI^-.R^+)aq$. This species is formed by OH-radical reaction with the alkyl iodide followed by a rapid solvent-assisted rearrangement from the outer to the inner charge-transfer complex. (auth)

2512 GAMMA-INDUCED COPOLYMERIZATION OF FLUORINE-CONTAINING DIENES WITH STYRENE. Ito, K.; Muramatsu, H.; Matsuda, T. (Government Industrial Research Inst., Nagoya, Japan). Nagoya Kogyo Gijutsu Shikensho Hokoku; 22: No. 3, 102-105(Mar 1973). (In Japanese).

The γ radioinduced copolymerizations of (2-chlorohexafluorocyclopentenyl)ethylene (CHCE), (tetrafluorocyclobutenyl)ethylene (TCE), and (2-chlorotetrafluorocyclobutenyl)-ethylene (CTCE) with styrene (St) at 25°C were investigated. The compositions of the copolymers were determined by ^1H- and ^{19}F-NMR spectroscopy. The values of r_1 and r_2 were: CTCE-St $r_1 = 0.16$, $r_2 = 0$; CHCE-St $r_1 = 0.71$, $r_2 = 0.50$; TCE-St $r_1 = 0.43$, $r_2 = 2.9$. (auth)

2513 SULFUR IMPURITIES IN ESR SPECTRA OF IRRADIATED CRYSTALS. Single Crystal of Cytosine Monohydrate. Herak, J. N. (Rudjer Boskovic Institut, Zagreb). J. Magn. Resonance; 12: No. 1, 54-59(Oct 1973).

In the irradiated single crystal of cytosine monohydrate the radical with $g_1 = 2.036$, $g_2 = 2.009$, and $g_3 = 2.001$ and a doublet structure has been attributed to the thio-cytosine species. Concentration of the thio-cytosine molecules depends upon the commercial source of the substance. The observed sulfur radical has a π-electronic character. The exact chemical structure could not be determined even with the aid of molecular orbital calculations. (auth)

2514 REACTIONS OF RADIATION-INDUCED I^*, I_2^-, AND I_3^- WITH ALCOHOL DEHYDROGENASE AND ALDOLASE. Quintiliani, M.; Shejbal, J.; Davies, J. V.; Ebert, M.; Gilbert, C. W. (Instituto Superiore de Sanita, Rome). Int. J. Radiat. Biol.; 24: No. 3, 243-255(Sep 1973).

Pulse-radiolysis experiments are described on the reactions occurring between the enzymes, yeast alcohol dehydrogenase (ADH), and rabbit muscle aldolase (ALD) and radioinduced transient species arising from the iodide ion (I^-). Rate constants for the reactions of iodine atoms ($I\cdot$) and the radical ion (I_2^-) with the two enzymes are reported, and some transient spectra are presented. Attempts to separate the reactions of the various species are described, and evidence given that ALD is, in general, less reactive than ADH with the transient species. The results clearly indicate that reactions of the enzymes with I_2^- are of greatest significance; reactions with I^* are of less importance, and I_3^- reactions only occur after the initial processes are completed. The role of these processes and the part played by the enzyme –SH groups in the radiation sensitivity of the enzymes are discussed. (auth)

2515 IRIDIUM(III) SALTS AS HOMOGENEOUS METAL CATALYSTS FOR HYDROGEN ISOTOPE EXCHANGE IN ORGANIC COMPOUNDS: A COMPARISON WITH HETEROGENEOUS IRIDIUM FOR THE DEUTERIATION OF ALKYLBENZENES.

Garnett, J. L.; Long, M. A.; McLaren, A. B.; Peterson, K. B. (Univ. New South Wales, Kensington, Australia). J. Chem. Soc., Chem. Commun.; No. 19, 749-750(10 Oct 1973).

Hydrogen exchange between organic compounds and heavy water is homogeneously catalysed by sodium chloroiridite; results for alkylbenzenes are compared with those from heterogeneous catalysis by iridium metal and are interpreted in terms of the role of π-complex intermediates. (auth)

2516 SPECTROPHOTOMETRIC STUDY OF GLASSY 2-PENTENE IRRADIATED AT 77°K. Stachowicz, W.; Owczarczyk, A. (Inst. of Nuclear Research, Warsaw). Radiochem. Radioanal. Lett.; 15: No. 3, 139-146(20 Oct 1973).

A spectrophotometric study on the structure of glassy pentene-2 γ-irradiated at 77°K is reported. (auth)

2517 RADIOCHEMICAL PROCESSES IN RADIOACTIVE COMPOUNDS. Gromov, V. V. Usp. Khim.; 42: No. 1, 121-130(Jan 1973). (In Russian).

Work on the effect of natural radiation of radioactive inorganic salts on their radiation chemical stability was analyzed. The basic principles of radiation-chemical processes in radioactive salts were examined, and the effect of recoil atoms, originating in radioactive decay, chemical impurities, and self-charging on the radiolysis mechanism in radioactive compounds is discussed. The effect of changing the rate of self-irradiation on the yield of decomposition products of some radioactive salts (sulfates of group II metals) is analyzed in detail. (au-trans)

2518 CHARGE TRAPPING PHENOMENA IN ANTHRACENE CRYSTALS AND THE INFLUENCE OF CRYSTAL DEFORMATION. Aris, F. C.; Lewis, T. J. (University Coll. of North Wales, Bangor, Eng.). J. Chem. Soc., Faraday Trans., I; No. 10, 1872-1886(1973).

Carrier generation and transport in single crystals of anthracene either undeformed or deformed mechanically were investigated using a drift technique in which carriers generated by a < 100 ns pulse of 10 keV electrons are studied as they are swept through the crystal in an applied electric field. In undeformed crystals the mobilities of electrons and holes are $\mu_e = 0.43 \times 10^{-4}$ and $\mu_h = 1.1 \times 10^{-4} m^2 v^{-1} s^{-1}$ respectively. The corresponding free lifetimes before trapping are $\tau_f^e > 2$ ms and $\tau_f^h > 100 \mu s$. The temperature dependences of these parameters are also reported. The total carrier yield is also obtained as a function of field but the value of the product $\mu\tau$ deduced from the yield, assuming a Hecht-type formula, is much lower than is expected from the direct evaluation of μ and τ as above. This is attributed to field-sensitive space-charge which alters the sample capacitance. Space-charge may also be responsible for the delayed generation of holes. Basal (001)[010] dislocations deliberately introduced by deforming give rise to deep electron traps (~ 1 eV) with long lifetimes which reduce τ_f^e to ~ 30 s. On the other hand τ_f^h is not reduced unless electrons are already trapped, whereupon they act as recombination centers. Point indentation (h01)[010] dislocations in surface layers appear to produce either recombination centers or independent electron and hole traps. Shallow trapping processes and symmetrical trap behavior as envisaged by Sworakowski (Mol. Cryst. Liquid Cryst; 11:1 (1970)) do not appear to occur as a result of dislocation. (auth)

2519 FURTHER STUDIES OF γ-IRRADIATED PROPYLENE CARBONATE GLASSES. Shaede, E. A. (Univ. of Saskatchewan, Saskatoon); Symons, M. C. R. Can. J. Chem.; 51: No. 15, 2492-2496(1 Aug 1973).

An earlier postulate, that physically trapped electrons are responsible for a narrow ESR singlet at g = 2.20028 formed by exposure of glassy propylene carbonate to ^{60}Co γ-rays at 77°K, is re-examined. An alternative, that propylene carbonate radical anions are formed, in which the extra electron is largely confined to an antibonding orbital on the carbonate moiety, is favored. The primary new evidence for this anion is the detection of satellite ESR lines which were lost on bleaching or thermal decay of the central line, and which occurred in the correct field regions to be assigned to ^{13}C hyperfine structure from the carbonate carbon of the anion. (auth)

2520 GAMMA-RAY INDUCED POLYMERIZATION OF VINYL MONOMERS IN BAGASSE. Wang, U. P. (Union Industrial Research Inst., China). J. Chin. Chem. Soc. (Taiwan); 20: No. 2, 57-73(Jun 1973).

Vinyl monomers such as vinyl acetate, vinyl chloride, methyl methacrylate and styrene etc., can be polymerized without catalyst into the composites of bagasse material by gamma-radiation induced in situ liquid polymerization process. The fundamental factors, such as polymerization-rate, effect of swelling agent, molecular weight of vinyl polymers and graft reaction between bagasse cellulose and vinyl polymers, have been investigated and discussed. The use of suitable low G-value polar swelling agents and the application of suitable gamma dose-rate are two key factors found to control the smooth in situ liquid polymerization system of vinyl monomers in bagasse. (auth)

2521 ELECTRON SPIN RESONANCE STUDY ON THE ACRYLIC ACID ANION RADICAL AND ITS PROTONATION IN SOME IRRADIATED FROZEN SOLUTIONS. Iwasaki, M.; Fukaya, M.; Fujii, S.; Muto, H. (Government Industrial Research Inst., Nagoya, Japan). J. Phys. Chem.; 77: No. 23, 2739-2744(8 Nov 1973).

An ESR study has been carried out for reactions of electrons with acrylic acid (AA) in a variety of irradiated frozen solutions. The electron adducts of acrylic acid $[CH_2-CH-COOH]^-$ were found to be formed in some matrices, such as 2-methyltetrahydrofuran (MTHF), triethylamine (TEA), and 3-methylhexane (MHX). The hyperfine couplings to the end CH_2 protons ($\alpha_0 \simeq 13$ G) are consistent with the INDO MO calculation made for the delocalized anion π radical. The post-irradiation thermal annealing of the frozen MTHF-AA solutions at 97°K resulted in protonation of the electron adducts to form the hydrogen addition radical $[CH_3-\dot{C}H-COOH]$. The same conversion was also observed in the TEA matrices at around 115°K, while no conversion was observed in the MHX matrices. The radical conversion seems to be associated with the molecular reorientations in the matrices which were found from the sudden change of the line width in the wide-line nmr measurements of frozen MTHF. On the other hand, the hydrogen addition radicals were found immediately after irradiation in some matrices containing polar protons such as alcohols and alkaline aqueous solutions. It is concluded that the electron adducts of acrylic acid can be stabilized either in a molecular anion or in its protonated form, depending upon the nature of the matrix molecules and that the hydrogen addition radicals are formed from the polar proton transfer to the electron adducts. A model of proton transfer from protonated cations via the hydrogen bond is proposed for protonation of the electron adducts in the MTHF and TEA matrices. (auth)

2522 REDUCTION OF DYES BY FREE RADICALS IN SOLUTION. Correlation Between Reaction Rate Constants and Redox Potentials. Rao, P. S.; Hayon, E. (Army Natick Labs., MA). J. Phys. Chem.; 77: No. 23, 2753-2756(8 Nov 1973).

The reactions of some free radicals (RH·) with a number of organic dyes (D) have been examined in aqueous solutions using the fast-reaction technique of pulse radiolysis. The radicals studied include $\cdot CH_2OH$, $(CH_3)_2\dot{C}OH$, $NH_2\dot{C}HCOO^-$, $\cdot C-OH$ (C = cytosine), ·TH (TH_2 = dihydrothymine), and $\cdot CH_2^-$ and were produced by reaction of the substrates with OH radicals. The dyes used were Crystal Violet, Safranine T, Phenosafranine, Indigo Di- and Tetrasulfonate, Methylene Blue, Thionine, Indophenol and 2,6-Dichloroindophenol. The electron transfer reactions, $RH\cdot + D \rightarrow R + \cdot D^- + H^+$ (k_1), were determined by following the bleaching kinetics of the dyes at the wavelengths where they absorb. The rates were found to increase monotonically with increase in the redox potential E_m of the dyes examined. Similarly the efficiencies (expressed in percentage) of these reactions were obtained and found to be markedly dependent upon the E_m values of the dyes in the range from −0.357 to +0.217 V. These results are discussed and the suggestion made that this correlation represents the dependence upon ΔE_m, the difference in the redox potentials of the donor radical and the acceptor dyes. (auth)

2523 OZONE FORMATION BY THE RADIOLYSIS OF LIQUID NITROGEN: CALCULATION AND MEASUREMENT. Gault, J. D. (Federal Univ. of Santa Catarina, Florianopolis, Brazil); Logan, K. W.; Danner, H. R. Nucl. Safety; 14: No. 5, 446-451(1973).

A simple experimental method is presented which allows an estimate of the amount of ozone present when oxygen-contaminated liquid nitrogen is exposed to a radiation field. Also, if the radiation level and the oxygen concentration are known, the amount of ozone formed can be calculated; in this case, there is good agreement. The results indicate that the concentration of the oxygen impurity is much less significant than previously supposed. Instead, the amount of liquid nitrogen remaining when the cryostat is refilled is the primary factor in determining the maximum amount of ozone that will be present at any time. (auth)

2524 ELECTRON IRRADIATION OF POLY(OLEFIN SULFONES). Application to Electron Beam Resists. Bowden, M. J.; Thompson, L. F. (Bell Telephone Labs., Murray Hill, NJ). J. Appl. Polym. Sci.; 17: No. 10, 3211-3221(Oct 1973).

All the poly(olefin sulfones) examined degraded rapidly under electron irradiation. The dose required to effect a molecular weight distribution completely separated from the original distribution as required for fractional solution development was similar for all polymers, viz., $1-2 \times 10^{-6}$ coulomb/cm^2. This indicates that they all have similar values for G(scission). The film thickness of the exposed area decreased at a rate dependent on olefin structure and temperature. This process, termed vapor development, has been attributed to concurrent chain scission and depolymerization. Factors determining the rate of depropagation are discussed. (auth)

2525 RADIATION-INDUCED SOLID-STATE POLYMERIZATION IN BINARY SYSTEMS. VII. Polymerization in Solid-Liquid Equilibrium Phase Containing Long-Chain Compounds. Kaetsu, I.; Ito, A.; Hayashi, K. (Atomic Energy Research Inst., Takasaki, Japan). J. Appl. Polym. Sci.; 17: No. 10, 3223-3233 (Oct 1973).

The radiation-induced polymerization of binary systems consisting of vinyl monomers (mainly methyl methacrylate) and various long-chain compounds in solid–liquid equilibrium state has been studied. Phase diagrams of these systems showed that all systems containing long-chain compounds form a complete crystalline phase at temperatures below the solidus line. It was found that remarkable acceleration of the polymerization occurred in the solid–liquid equilibrium state. The long-chain compounds are classified into three groups according to the acceleration effect. The group including paraffin, long-chain esters, and cetyl alcohol exerted the largest acceleration effect over wide temperature regions at which the solid–liquid equilibrium exists. Maximum polymerization rate was observed at temperatures below the melting point in the presence of long-chain compounds of the above-mentioned group. It was observed in this case that the long-chain compounds crystallized to form very fine colloidal particles and the system was soft and waxy in the solid–liquid equilibrium state. The acceleration of the polymerization in the binary system consisting of a vinyl monomer and a compound having no long-chain substituents or in the homogeneous solution consisting of monomer and viscous solvent were far less than that in the presence of long-chain compounds. It is suggested that the effect can be attributed to the effect of a special reaction matrix favorable to polymerization in the solid–liquid equilibrium. (auth)

2526 GAS-PHASE INCULCATED POLYMERIZATION OF CHLOROPRENE WITH POLYETHYLENE SUBJECTED TO γ RADIATION. Arshakuni, R. G.; Gabrelyan, G. A.; Gol'din, V. A. (Inst. of Physics Research, Kiev). Arm. Khim. Zh.; 24: No. 4, 311-315(1973). (In Russian).

The possibility of copolymerization of inculcated chloroprene in gaseous phase subjected to γ radiation with polyethylene membrane is demonstrated. The presence of oxygen stimulates the process. The infrared spectrum of the inculcated copolymers shows that copolymerization is realized mainly by the trans-1,4 mechanism. (auth)

2527 STABLE PRODUCT YIELDS FROM THE γ IRRADIATION OF 3 METHYLPENTANE-h_{14} GLASS, LIQUID, AND GAS AND 3 METHYLPENTANE-d_{14} GLASS. Mainwaring, D. D.; Willard, J. E. (Univ. of Wisconsin, Madison). J. Phys. Chem.; 77: No. 24, 2864-2867(22 Nov 1973).

Yields from the γ-irradiation of 3-methylpentane-h_{14} (3MP-h_{14}) as a gas (300°K), liquid (273°K), and glass (77°K), and from the γ-irradiation of 3MP-d_{14} glass, were determined for 40 products in the mass range from H_2 to C_{12} hydrocarbons. The G values (molecules per 100 eV absorbed) for total products from the gas, liquid, and glass are 16.6, 12.7, and 9.0, respectively. The yields of C_6 compounds (isomers of 3MP and olefins) are all lower in the liquid than the glass and in the gas than the liquid, whereas the yields of most other products are higher in the liquid than the glass, and in the gas than the liquid, but with major differences in the magnitude of these phase effects. The yield of each hydrocarbon product from 3MP-d_{14} is essentially the same as that from 3MP-h_{14}. (auth)

2528 SECONDARY EFFECTS DUE TO THE PRESENCE OF SULFUR HEXAFLUORIDE IN HYDROCARBON RADIOLYSIS. Niedzielski, J.; Gawlowski, J. (Univ., Warsaw). J. Phys. Chem.; 77: No. 24, 2853-2856(22 Nov 1973).

SF_6, used as an electron scavenger in the radiolysis of gaseous ethylene and propane, is found to decompose with a yield close to the yield of electrons. The products of SF_6 decomposition do not compete with parent molecules for electrons. The radiolysis of gaseous ethylene-cis-2-butene-1,3-butadiene-SF_6 mixtures reveals that secondary products, derived from SF_6, react with butadiene and act as chain carriers of cis-trans isomerization. Both processes involve the same radical species. A free-radical mechanism is established on the basis of photoelectron and vacuum-uv photolysis experiments. (auth)

2529 SPUR RECOMBINATION AND DIFFUSION PROCESSES IN PULSE IRRADIATED INORGANIC GLASSES. Barkatt, A.; Ottolenghi, M.; Rabani, J. (Hebrew Univ., Jerusalem). J. Phys. Chem.; 77: No. 24, 2857-2863(22 Nov 1973).

Pulse radiolysis studies are carried out in pure and doped metaphosphate, borate, and silicate glasses in the range between 80 and 315°C. The observed decay patterns are shown to be due to the recombination of ions, holes, and electron centers, within spurs. The time dependence of the fraction of surviving radicals is in good agreement with the empirical expression $F(t) = \exp(k_s/\alpha)\ \mathrm{erfc}\ (k_s t/\alpha)^{1/2}$ (where α is a constant and k_s is the diffusion controlled recombination rate constant) predicted by Rzad, et al., for systems undergoing spur recombination processes. Differences of several orders of magnitude among the diffusion coefficients of the various ions and centers explain the large variations in the rates of the corresponding diffusion-controlled electron-transfer reactions in glasses. The possibility of calculating relative diffusion coefficients in glasses from the annihilation data is discussed. Results indicate that the diffusion coefficient of Mn^{2+} is $(3 \pm 1) \times 10^3$ higher than that of Cd^+ in the temperature range 80 to 240°C. (auth)

2530 PULSE RADIOLYSIS OF MERCURIC ION IN AQUEOUS SOLUTIONS. Fujita, S.; Harii, H.; Taniguchi, S. (Radiation Center of Osaka Prefecture, Sakai, Japan). J. Phys. Chem.; 77: No. 24, 2868-2871(22 Nov 1973).

The pulse radiolysis method was used to study deaerated aqueous solutions of the mercuric ion in the wavelength range 220 to 300 nm. The transient mercurous ion gave two absorption maxima at 225 and 250 nm with $\epsilon^{255} = (1.4 \pm 0.1) \times 10^4\ M^{-1}\ sec^{-1}$. Stable mercurous ion, Hg_2^{2+}, was formed via an additional step after the disproportionation reaction of the initial species: $Hg^+ + Hg^+ \rightarrow Hg^0 + Hg(II)$; $Hg^0 + Hg(II) \rightarrow Hg_2^{2+}$. The formation rate of Hg_2^{2+} depended on the concentration of mercuric ion and the pH of the solution. The result was ascribed to the reaction of Hg^0 with three partially hydrolyzed species of mercuric ion. Rate constants for the reactions were determined. (auth)

2531 RESOLUTION OF THE OPTICAL SPECTRA OF SODIUM SOLUTIONS IN LIQUID AMMONIA INTO TWO EXPERIMENTALLY UNRESOLVABLE BANDS. Rubinstein, G.; Tuttle, T. R. Jr.; Golden, S. (Brandeis Univ., Waltham, MA). J. Phys. Chem.; 77: No. 24, 2872-2877(22 Nov 1973).

Spectra of the solvated electron were determined at –55, –65, and –75°C for solutions in NH_3 and in NH_3 0.08 M in NaI by extrapolations to infinite dilution. Spectra obtained for $Na-NH_3$ solutions and for $Na-NH_3-NaI$ solutions were shown to fulfill the expectations of a two absorber model. The data rule out the possibility that the second absorber incorporates only a single solvated electron. The data support the assumption that the second absorber involves a binary combination of solvated electrons. Spectra of the second absorber are obtained at all three temperatures and for solutions in both NH_3 and in NH_3 0.08 M in NaI. Spectra due to Gold and Jolly appear to be characteristic of the second absorber and not the solvated electron. (auth)

2532 SITE OF ATTACK OF THE HYDROXYL RADICAL ON THE PYRIMIDIC RING. Thymine and Thymidine Peroxides. Cadet, J.; Teoule, R. (CEN, Grenoble, France). Compt. Rend., Ser. C; 276: No. 25, 1743-1746(18 Jun 1973). (In French).

The action of γ-rays on thymine in aerated aqueous solution was studied. For pH values of <1.7, the preferential formation of 5-hydroperoxy-6-hydroxy-5,6-dihydrothymine occurs, and for pH values of >1.7 the formation of 6-hydroperoxy-5-hydroxy-5,6-dihydrothymine occurs. Similar results are obtained for thymidine. The substitution of a halogen in position 5 in 5,6-halohydrines of 2,4-dioxopyrimidines by a perhydroxyl (or hydroxyl) ion using hydrogen peroxide (or water) in the presence of silver oxide is accompanied by the transposition from position 6 to position 5 of the hydroxyl initially present in the ring. The entering nucleophile grouping positions itself at position 6. Thus 5-bromo-6-hydroxy-5,6-dihydrothymine yields under these conditions 6-hydroperoxy-5-hydroxy-5,6-dihydrothymine. The stereochemistry of this reaction is given for thymidine. The action of hydrogen peroxide on the cis-glycol of thymine in an acid medium quantitatively yields 6-hydroperoxy-5-hydroxy 5,6-dihydro-cis-thymine. (FR)

2533 ESR STUDY ON RADIATION CHEMICAL PROCESSES IN POLYVINYL ALCOHOL FILMS AT 77°K. Hase, H.; Yamaoka, H. (Kyoto Univ., Osaka). Radiat. Eff.; 19: No. 3, 195-197 (1973).

Trapped electrons (e_t^-) were detected in irradiated PVA films at 77°K. The yield of e_t^- was decreased as water was evaporated from the films, indicating that water molecules contribute to construction of pre-existing traps in the polymer. The radical produced at 77°K was identified as a precursor of the radical produced at room temperature. (auth)

2534 CALCULATION OF HYDROGEN GENERATION FROM PLUTONIUM INDUCED ALPHA RADIOLYSIS OF NITRIC, SULFURIC, AND PERCHLORIC ACIDS. Weiss, J. R.; Pietri, C. E.

(New Brunswick Lab., NJ). Radiat. Eff.; 19: No. 3, 191-193 (1973).

Hydrogen buildup in stored plutonium solutions can be an explosion hazard. From available data on radiolysis induced by plutonium alpha particles, hydrogen generation was calculated for nitric, sulfuric, and perchloric acid solutions at various plutonium concentrations, acid concentrations, and Pu isotopic compositions. The method is stated, and the results are tabulated. (UK)

2535 ELECTRON-SCAVENGING PROCESS IN 3-METHYLHEXANE GLASS AT 77°K STUDIED BY ESR. Oka, K.; Yamazaki, H.; Shida, S. (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap.; 46: No. 8, 2347-2352(Aug 1973).

The effects of various additives, i.e., nitrous oxide, sulfur hexafluoride, methyl chloride, and sulfur dioxide, on the yield of the trapped electrons produced in the γ-irradiated 3-methylhexane (3MHX) glass at 77°K have been investigated by the ESR technique. The yields of the trapped electrons were reduced by the addition of all the solutes examined; the efficiency of electron scavenging was found to be in the order of $SF_6 > CH_3Cl > N_2O > SO_2$. The concentration dependence of the electron scavengers showed that the efficiency of the electron scavenging in the glassy state had values intermediate between those in the gas and liquid phases. The high efficiency observed in the glassy state suggests that the non-solvated electrons before being trapped move about rapidly in the glassy matrix as the form of quasi-free electrons. The ESR-power saturation of the trapped electrons was considerably reduced by the addition of N_2O; a possible mechanism of the relaxation of the ESR is proposed. (auth)

2536 RADIATION-INDUCED COPOLYMERIZATION OF TETRAFLUOROETHYLENE WITH ETHYLENE. Yamabe, M. (Asahi Glass Co. Ltd., Tokyo); Miyake, H.; Ukihashi, H.; Tabata, Y. Asahi Garasu Kenkyu Hokoku; 23: No. 1, 61-70(Jul 1973).

Radiation-induced copolymerization of tetrafluoroethylene with ethylene in solution was investigated by employing various chlorofluorohydrocarbons as solvent. The maximum copolymerization rate was obtained at the mole fraction of monomers in the range of 0.3 to 0.4. The rate was proportional to half or one power of the dose rate depending on the solvents used. The molecular weights of the copolymers were evaluated by a novel method based on activation analysis. The copolymer showed a crystalline structure composed of a repeating unit, $(-CH_2-CH_2-CF_2-CF_2-)$, which was found out by the studies of sequence distribution of each monomer, melting temperature, and x-ray analysis. (auth)

2537 GAMMA-INDUCED AND THERMAL REACTIONS OF ALLYL ACETATE WITH AMINES. Oka, K.; Ogawa, K.; Fukumoto, T.; Tsurugi, J. (Radiation Center of Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 111-112 (Mar 1973).

Gamma-induced addition of isopropylamine and piperidine to allyl acetate is described. Piperidine, however, gave N-acetylpiperidine in addition to the adduct. The acetamide was considered to be formed during treating the irradiated mixture. The aminolysis of allyl acetate with diethylamine and cyclohexylamine and of allyl chloroacetate with isopropylamine are also described. (auth)

Radiochemistry and Nuclear Chemistry

2538 (ARH-2537) DETECTION LIMITS FOR RADIOISOTOPIC COUNTING TECHNIQUES. Hartwell, J. K. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 22 Jun 1972. 17p. Dep. NTIS $3.00.

The method of defining detection limits which has been adopted by the 222-S Analytical Laboratory counting room is described. The system for reporting limits defines two levels of detection limits: the critical level (L_C) which must be exceeded before a sample can be said to contain any material above the background level and a detection limit (L_D) at which we can be 95% sure that we will detect material. The common method of using twice the standard deviation of the background as a lower detection limit was found to lead to erroneous results. Equations relating L_C and L_D to the magnitude and standard deviation of the background were derived. Two examples illustrate the use of these levels. (auth)

2539 (COO-3513-94) STUDIES IN NUCLEAR AND RADIOCHEMISTRY. Progress Report for the Period June 16, 1972–September 14, 1973. Final Report. (Rutgers—The State Univ., New Brunswick, N. J. (USA)). [nd]. Contract AT(11-1)-3513. 23p. Dep. NTIS $3.25.

Research reported in articles submitted for publication and those published during the recent report period is reviewed. In addition, a bibliography of 121 articles published on research carried out for the USAEC during the past 14 years is included. (JGB)

Hot-Atom Chemistry

Refer also to abstract 3678.

2540 (JINR-P6-7203) CHEMICAL BEHAVIOR OF THE Zr AND Y RECOIL NUCLEI IN Zr AND Y ACETYLACETONATES IRRADIATED WITH 660 MeV PROTONS. Zaitseva, N. G.; Islamova, Kh. M.; Nguyen Huynh Mai; Ronno, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The interaction of zirconium and yttrium acetylacetonates with high energy protons was studied. The distribution of zirconium and yttrium recoil nuclei in different chemical forms (chelate, ligand-deficient and inorganic ionic forms) as well as its dependence on the conditions at which the irradiation is performed such as the aggregate state of the chelates (crystals or solution), the influence of air (bombardment in the presence of air or in vacuum) was evaluated. The results obtained show that the behavior of recoil nuclei depends on the experimental conditions and the method of the analysis used. By setting certain experimental conditions recoil nuclei can be produced with the predominant yield of one or another chemical state. (auth)

2541 (ORO-3898-19) REACTIONS OF HIGH ENERGY RADIOACTIVE ATOMS RESULTING FROM NUCLEAR TRANSFORMATIONS IN THE SYSTEMS OF SILICON-CONTAINING COMPOUNDS. Progress Report, February 1973–January 1974. Tang, Y. N. (Texas Agricultural and Mechanical Univ., College Station (USA). Research Foundation). 1974. Contract AT(40-1)-3898. 97p. Dep. NTIS $7.00.

The major progress during this period was in the study of chemical reactions involving energetic ^{31}Si and ^{32}P atoms formed by the nuclear recoil technique. The results obtained have given certain penctrating insights into the nature of interactions by such multivalent species. For the recoil ^{31}Si studies, it was ascertained that silylene-^{31}Si formed by ^{31}Si atom abstraction reactions adds to 1,3-butadiene to give silacyclopent-3-ene-^{31}Si. Studies using nitric oxide as a scavenger demonstrate that the reacting silylene is present as 80% triplet and 20% singlet, while studies using neon as a moderator prove that the ground electronic state of silylene is a singlet. For the recoil ^{32}P studies, the relative efficiencies of hydrogen abstraction by recoil ^{32}P atoms in the gas phase was found to cover a range of two orders of magnitude for five different molecules. Unmistakable evidence was obtained here showing that the primary factor controlling the ^{32}P abstraction reaction is the bond strength, as measured by the bond dissociation energies. (auth)

2542 REACTION OF FISSION PRODUCTS WITH SOLID CHLORIDES. Neidhart, B. (Technische Univ., Darmstadt, Ger.). (1973). vp.

From 7th international hot atom chemistry symposium; Juelich, Germany (10 Sep 1973).

Uranium-235 fission products were stopped in solid chlorides and the release of the chemical compounds (chlorides and oxychlorides) of several products was investigated. The selectivity, the delay-time, and the yield of the volatilization are influenced by the catcher-chloride, the temperature and the carrier gas. At temperatures of 500 to 700°C, 50 to 90% of Tc was selectively released from a KCl catcher. The delay times were measured in the range of 3 to 6 min. The release of Tc was accelerated by increasing the temperature and adding $ZrCl_4$ as carrier. The experiments showed that neither the grain size of the chloride nor the stream velocity of the transport gas (N_2) affected the delay times, whereas the nature of the solid chloride affected the selectivity, the delay times as well as the yields to a very large extent. These effects are discussed and a preliminary picture of a possible reaction mechanism is given. (GE)

2543 TEMPERATURE DEPENDENT CHEMICAL EFFECTS OF THE $^{57}Co(EC)^{57}Fe$ REACTION IN $Cd_3[^{57}Co(CN)_6]_2 \times 12H_2O$. Fenger, J. (Danish Atomic Energy Commission, Risoe). (1973). vp.

From 7th international hot atom chemistry symposium; Juelich, Germany (10 Sep 1973).

The chemical effects of the $^{57}Co(EC)^{57}Fe$ reactions taking place in crystals containing $^{57}Co(CN)_6^{3-}$ ions were studied by Moessbauer emission spectroscopy. The main reaction is a decoupling of a CN-ligand by Coulomb-repulsion to form an iron pentacyanide; this effect can be prevented if the electrons, lost by the Auger cascade, are substituted sufficiently rapidly from the surroundings. More detailed studies with $Cd_3[^{57}Co(CN)_6]_2 \times 12H_2O$ indicate that the yield of the iron pentacyanide increases with temperature; this is explained by assuming that the decoupled CN-ligand must be able to diffuse away, in order not to recombine immediately with the pentacyanide. The interpretation of the results is complicated by the fact that the pentacyanide is less tightly bound in the lattice and consequently has a lower f-factor. Experimental results and theoretical considerations suggest that at room temperature an $^{57}Fe(III)(CN)_5^{2-}$ ion is detected with a probability that is only about 50% of that of an $^{57}Fe(III)(CN)_6^{3-}$ ion. (GE)

2544 IDENTIFICATION OF HIGH BOILING COMPOUNDS FORMED IN RADIOLYSIS AND IN TRITIUM RECOIL REACTIONS IN ORGANIC MEDIA. Filatov, E. S.; Kukin, P. P.; Ivanov, Yu. A. (Moscow State Univ.). Radiochem. Radioanal. Lett.; 15: No. 3, 157-165(20 Oct 1973).

Thin-layer chromatography was applied to determine the yields of high boiling compounds formed in tritium recoil reactions and in the accompanying radiolysis of organic compounds. The procedure described makes the rapid separation of high boiling compounds (earlier referred to as "polymer" of unknown nature) possible from irradiated benzene, cyclohexane, and cyclohexene. (auth)

2545 RADIOCHEMISTRY OF ORGANOIRON COMPOUNDS. 3. $Fe(CO)_5$-Cyclopentadiene Solutions. Kanellakopulos Drossopulos, W. (Kernforschungszentrum, Karlsruhe, Ger.); Wiles, D. R. Can. J. Chem.; 51: No. 2, 215-218(15 Jan 1973).

Nucleogenesis of ^{59}Fe gives iron atoms which react with monomeric cyclopentadiene to produce $^{59}FeCp_2$, either in liquid or solid solutions, but do not react appreciably with dimeric cyclopentadiene. This is taken as showing that local thermal effects of the nuclear reactions are ineffective in causing the dissociation $(C_5H_6)_2 \rightarrow 2C_5H_6$. The concentration dependence of the yield of $^{59}FeCp_2$ indicates that the ^{59}Fe atom reacts primarily at its point of genesis rather than after diffusion. (auth)

2546 CHEMICAL EFFECTS FOLLOWING THERMAL NEUTRON CAPTURE IN PERBROMATE. Hassan, N.; Heitz, C. (CNRS, Strasbourg, France). (1973). vp.

From seventh international hot atom chemistry symposium; Juelich, Germany (10 Sep 1973).

Perbromates of alkali metals were irradiated in a thermal neutron flux of 10^{12} cm^{-2} s^{-1}. Separation of the various chemical forms of radiobromine was performed by dissolving the irradiated samples in 10^{-2}M NaOH solution and subsequent high voltage electrophoresis. The following radiobromine distribution was found: Br^- (73 ± 2%), BrO_3^- (24 ± 1%) and BrO_4^- (1 ± 0.5%). No isotope effect was observed. By thermal annealing oxidation of bromide to bromate occurs and an isotope effect is observed, $^{82}Br^-$ ions being oxidized more rapidly than $^{80m}Br^-$ ions. This effect is attributed to the $^{82m}Br \rightarrow {}^{82}Br$ isomeric transition. Analysis of the annealing curves shows that oxidation of $^{80m}Br^-$ occurs through a first order reaction the activation energy of which is 11.4 kcal M^{-1}, whereas $^{82}Br^-$ is oxidized through a more complicated mechanism. No re-entry reaction, i.e. production of labelled perbromate by annealing, is observed. (GE)

Properties of Radioactive Materials

Refer also to abstracts 2441, 2461, 2517, 2962, and 4066.

2547 (AERE-R-7480) TECHNIQUES FOR RECORDING SOLID STATE TRANSMISSION SPECTRA OF RADIOACTIVE COMPOUNDS. Brown, D.; Whittaker, B.; Edwards, J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Aug 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

Methods are described for recording solid state transmission spectra using 1 to 10 mg of radioactive actinide compounds in the range 0.2 to 2.2 μ ($5f^q \rightarrow 5f^{q-1}6d$ and $5f^q \rightarrow 5f^q$ transitions). Factors that influence the quality of the spectra are discussed. (auth)

2548 (BARC-670) MOLTEN SALT CHEMISTRY. Part I. Preparation of CeF_3, PuF_3, ThF_4, and Purification of $LiF-BeF_2-ThF_4$ Mixture. Iyer, P. N.; Prasad, R.; Vaidya, V. N.; Nag, K.; Singh, Z.; Sood, D. D.; Ramaniah, M. V. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

Equipment set up for the preparation of CeF_3, PuF_3, and ThF_4 and purification of $LiF-BeF_2-ThF_4$ mixture for the determination of solubility of CeF_3 and PuF_3 in ternary mixtures of $LiF-BeF_2-ThF_4$ and binary mixtures of $LiF-ThF_4$ is described. Using this equipment the preparation of 75 g of CeF_3 tagged with ^{144}Ce and 60 g of PuF_3 and purification of 1.2 kg of $LiF-BeF_2-ThF_4$ mixture have been carried out. The analysis of compounds for fluoride by pyrohydrolysis and the estimation of Li, Be, and Th in the salt mixture has been reported. (auth)

2549 (BARC-671) MOLTEN SALT CHEMISTRY. Part II. Solubility of CeF_3 in Molten $LiF-BeF_2-ThF_4$ Mixture. Iyer, P. N.; Prasad, R.; Vaidya, V. N.; Nag, K.; Singh, Z.; Sood, D. D.; Ramaniah, M. V. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

The assembly of a recirculating argon atmosphere dry box for the determination of the solubility of PuF_3 and the apparatus used for the determination of the solubility of CeF_3 and PuF_3 are described. The solubility of CeF_3 has been determined in a ternary mixture of $LiF-BeF_2-ThF_4$ (66.5, 19, 14.5 m/o) in the temperature range 550-800°C as a stand-in for PuF_3. The solubility values and the heat of solution agree reasonably well with the values reported by ORNL for similar salt compositions. (auth)

2550 (FRNC-TH-402) SYNTHESIS OF ^{14}C LABELED FATTY ACIDS OF THE METHYL GROUPS. Bellon-Gronnier, A. (Paris-6 Univ., 75 (France)). 1973. 323p. (In French). Dep. NTIS (U. S. Sales Only) $18.25.

Thesis.

Some general aspects of the synthesis of labeled molecules are recalled. The different methods envisaged for the preparation of fatty acids, such as lauric acid, are described. This acid was, in fact, prepared by the condensation of $^{14}CH_3I$ with sodated derivatives of alkyne N-N-dimethylamides, a yield of 44% being obtained. Palmitic and stearic acids were also prepared by this method with yields of 38 and 56% respectively. Attempts to synthesize cis-9, cis-12, ^{14}C-18 octadecadienoic acid (linoleic acid) are described. (FR)

2551 (INIS-mf-704) PREPARATION AND PURIFICATION OF RADIOACTIVELY LABELLED FLUORESCENT COMPOUNDS FOR MEDICAL USE. Balakrishnan, S. A. (Bombay Univ. (India)). 1970. 72p. INIS.

Thesis.

Methods of preparation of ^{203}Hg-labeled fluorescein derivatives and ^{131}I-trace-labeled folic acid were investigated with a view to develop radioisotopically labeled fluorescent compounds for use in diagnostic medicine as specific localizing and scanning agents with reduced radiation dose to patients. Fluorescein and its derivatives are labeled with ^{203}Hg by treating them with ^{203}Hg-labeled mercuric acid at pH ranging from 3 to 7 and also with ^{203}Hg-labeled mercuric nitrate at pH ranging from 1 to 7. A pH value of 3 was found to give the best results. For purification of the ^{203}Hg-labeled product, unbound mercury has to be separated. For separation of unbound mercury from the product, column chromatography on alumina was found better than either acid precipitation, as the product undergoes demercuration at low pH, or cation exchange chromatography. For evaluation of radiochemical purity both paper electrophoresis and paper chromatography methods are found to be unsuitable. A new analytical method based on complexing mercury with thiosulfate ions in paper electrophoresis was developed. This method is found to be suitable for evaluation of the radiochemical purity of some of the other radiomercury organo-mercurials such as 3-chloromercuri-2-methoxypropylurea, acetoxymercuri-hydroxypropane, mercurated bromosulfalein mersalyl, and mersalyl acid. Sterilization by filtering through a bacteriological filter under aseptic conditions does not affect the stability of the labeled product as does sterilization by steam in an autoclave. Studies on shelf life under different conditions are reported. For investigation of trace-labeling of folic acid, ^{131}I-labeled iodine monochloride, and ^{131}I-labeled hypoiodide are used. The latter gives better results, as it gives enhanced specific activity in the labeled compound, and the iodination reaction can be controlled. Out of three methods of purification of the product namely, selective precipitation, removal of iodide using AgCl-AgI suspension, and column chromatography on DEAE-cellulose, the last one is found to be the most effective. Sterilization of the product by bacteriological filter under aseptic conditions is found to be more suitable than sterilization by steam in an autoclave. (INIS)

2552 HYDROLYSIS OF THORIUM IONS IN AQUEOUS SOLUTIONS. Onosov, V. N. Tr. Ural. Politekh. Inst.; 193: 21-27 (1971). (In Russian).

The literature on thorium hydrolysis is reviewed. (42 references) (TTT)

2553 ELECTROCHEMICAL BEHAVIOR OF URANIUM ON A MERCURY ELECTRODE IN AQUEOUS SOLUTIONS. Enikeev, R. Sh.; Khan, S. I.; Kozlovskii, M. T. (Kazakhstan State Univ., Alma-Ata, USSR). Usp. Khim.; 42: No. 1, 26-38(Jan 1973). (In Russian).

On a mercury electrode, hexavalent uranium in aqueous solution is reduced to tetravalent or trivalent compounds, and in some cases even to metal. A number of stages of the cathode process are observed, and the final valence form of the uranium depends on the composition of the solution, especially on the presence of complex formers and the pH of the medium. Polarography of uranium as an analytical method is at present of limited application. (auth-trans)

2554 4,4′-BIPYRIDINE COMPLEXES WITH SOME URANYL SALTS. Ahuja, I. S.; Singh, R. (Banaras Hindu Univ., India). Aust. J. Chem.; 26: No. 9, 1871-1876(Sep 1973).

The complexes formed by 4,4′-bipyridine with uranyl chloride, sulphate, and nitrate of the type $UO_2(4,4'\text{-bipyridine})X_2$, where X = Cl or $\frac{1}{2}SO_4$, and $UO_2(4,4'\text{-bipyridine})_{1.5}(NO_3)_2$ were prepared and their infrared spectra in the rock salt and low-frequency region (down to 200 cm^{-1}) studied in the solid state. Ir spectra of these complexes show that 4,4′-bipyridine acts as a bidentate ligand bridging between two metal atoms. It is suggested that the sulphate and nitrate groups act as bidentate chelating ligands and the complexes are polymeric structures. (auth)

2555 CHLORINE, BROMINE, IODINE, AND ASTATINE. Downs, A. J.; Adams, C. J. (Oxford Univ.). pp 1107-1594 of Comprehensive Inorganic Chemistry. Volume 2. Trotman-Dickenson, A. F. Oxford; Pergamon Press Ltd. (1973).

A review is presented on chlorine, bromine, iodine, and astatine that considers general properties of the halogen group; discovery and history; natural occurrence; production; uses; atomic chlorine, bromine and iodine; physical properties of molecular halogens; chemical properties; analytical chemistry; biological action of elementary halogens; halide ions and related species: oxidation state −1; derivatives of chlorine, bromine, and iodine in positive oxidation states; and astatine. (1098 references) (DHM)

2556 HYBRIDIZATION OF ^{125}I-LABELED RIBONUCLEIC ACID. Tereba, A.; McCarthy, B. J. (Univ. of Washington, Seattle). Biochemistry; 12: No. 23, 4675-4679(6 Nov 1973).

A detailed characterization of the iodination of RNA using ^{125}I is described. A modification of the Commerford technique allows specific activities in excess of 3×10^7 cpm/μg to be obtained routinely. The iodinated RNA retains specificity in DNA−RNA hybridization with only a negligible decrease in the stability of DNA−RNA hybrids. (auth)

2557 DEPENDENCE OF FLOW DIRECTION ON THE ELECTROLYTE CONDITION IN ELECTRO-OSMOSIS WITH ALTERNATING CURRENT. II. Laszlo, Z. Z. Phys. Chem. (Leipzig); 253: No. 3/4, 145-152(1973). (In German).

The investigation aimed at clarifying the influence of the electrolyte condition on the alternating current electro-osmosis with diaphragms containing conical capillaries. The electrolyte condition strongly affected the flow direction of electro-osmosis when the diaphragm contained capillaries with large diameters. The specific effect of electrolytes disappeared at capillaries with smaller diameters. Among the electrolytes investigated are $ThCl_4$ and $Th(NO_3)_4$. (tr-auth)

2558 CATALYSIS OF THE REACTION BETWEEN URANIUM TETRAFLUORIDE AND OXYGEN. A Novel Approach to the Preparation of Uranium Hexafluoride by a Method Not Requiring the Use of Fluorine. Ekstrom, A.; Batley, G. E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Inorg. Nucl. Chem. Lett.; 9: No. 11, 1157-1161(Nov 1973).

The preparation of UF_6 by reaction between UF_4 and O_2 suffers from the disadvantage that the high temperature required to give an economical oxidation rate causes excessive corrosion and leads to sintering of the UF_4. It was found, however, that the reactions involved can be catalyzed by small quantities of Pt or other selected metal catalysts. The Pt catalyst used in the study described was a commercial material consisting of 5 wt % Pt on γ-Al_2O_3. It was found that at 640°C, in the presence of 1 wt % of the catalyst, the reaction was 50% complete in 5 min., whereas in the absence of catalyst, at the same temperature the reaction was only 7% complete in the same time. A catalytic effect was noticeable at catalyst concentrations as low as 0.1 wt %. Ru, Rh and Ir also promoted the reaction, although not as effectively as Pt. The observed catalytic effect is unusual in that a sole catalyst enhances the rate of reaction between a gas and a solid, and it is thought that the results represent the first demonstration that this can occur for oxidation reactions. The most plausible explanation would appear to be that the gaseous reactant is adsorbed on the catalyst surface and is subsequently desorbed either in the atomic form or some other activated form. (UK)

2559 THERMAL DECOMPOSITION OF OXALATES. 13. Surface Area Changes in the Thermal Decomposition of Uranyl Oxalate. Dollimore, D.; Jones, L. F.; Nicklin, T.; Spooner, P. (Univ. of Salford, Eng.). J. Chem. Soc., Faraday Trans., I; No. 10, 1827-1833(1973).

The thermal decomposition of uranyl oxalate trihydrate was studied, and the surface area changes associated with the isothermal decomposition of the anhydrous salt in air were determined. The maximum in surface area recorded in the isothermal decomposition coincides with an inflexion in the weight loss data, which is not due to the formation of an intermediate compound. The nitrogen adsorption isotherms indicate that the probable cause of this inflexion is the development and eventual collapse of a porous structure in the solid, leading to an acceleration of the oxide formation. (auth)

2560 TEMPERATURE AND SOLVENT EFFECTS ON THE EQUILIBRIUM OF DILUTE URANIUM TRIFLUORIDE SOLUTIONS CONTAINED IN GRAPHITE. Toth, L. M.; Gilpatrick, L. O. (Oak Ridge National Lab., TN). J. Phys. Chem.; 77: No. 23, 2799-2803(8 Nov 1973).

The equilibrium of dilute UF_3-UF_4 molten fluoride solutions in contact with graphite and UC_2, $3UF_4 + UC_2 \rightleftharpoons 4UF_3 + 2C$, has been studied as a function of temperature (370-700°) and melt composition. Equilibrium quotients, $Q = (UF_3)^4/(UF_4)^3$, for the reaction were determined by measuring the UF_3 and UF_4 concentrations spectrophotometrically. It has been found that the equilibrium quotient is sensitive to both temperature and solvent changes, increasing as either the temperature increases or the alkali-metal fluoride content of the solvent decreases. These results are explained by the tendency of UF_4 to form complexes of greater stability than UF_3. Differences in the heats of solution of these uranium solutes are estimated from these data. (auth)

2561 THERMOPHYSICAL PROPERTIES RESEARCH LITERATURE RETRIEVAL GUIDE, SUPPLEMENT I, 1964−1970. Volume 2. Organic Compounds and Polymeric Materials. Touloukian, Y. S. (ed.). New York; Plenum Publishing Corporation (1973). 227p.

The six-volume supplement to the Basic Edition (1967) of Thermophysical Properties Research Literature Retrieval Guide reports an additional 26,000 (to the original 33,700) references on sixteen thermophysical properties of 20,000 materials, covering the years from mid-1964 to 1971. An additional 9,000 synonymns and trade names are cross-referenced to aid the user in identifying the material or substance of interest. This second volume of the six-volume supplement deals with organic compounds and polymeric materials. A bibliography and an author index are included. (JGB)

2562 THERMOPHYSICAL PROPERTIES RESEARCH LITERATURE RETRIEVAL GUIDE, SUPPLEMENT I, 1964−1970. Volume 5. Mixtures and Solutions. Touloukian, Y. S. (ed.). New York; Plenum Publishing Corporation (1973). 246p.

The six-volume supplement to the Basic Edition (1967) of Thermophysical Properties Research Literature Retrieval Guide reports an additional 26,000 (to the original 33,700) references on sixteen thermophysical properties of 20,000 materials, covering the years from mid-1964 to 1971. An additional 9,000 synonymns and trade names are cross-referenced to aid the user in identifying the material or substance of interest. This fifth volume of the six-volume supplement deals with mixtures and solutions. A bibliography and an author index are included. (JGB)

2563 STUDIES ON THE PENTACARBONYLTECHNETIUM RADICAL. de Jong, I. G.; Wiles, D. R. (Carleton Univ., Ottawa). Inorg. Chem.; 12: No. 11, 2519-2522(Nov 1973).

A species believed to be the $\cdot{}^{99m}Tc(CO)_5$ radical is produced in high yield on the β decay of $^{99}Mo(CO)_6$ in the solid state. This species is found to be scavenged by rapid exchange with $IMn(CO)_5$ to give $ITc(CO)_5$ and is destroyed by nitric oxide. It reacts slowly with photochemically produced $\cdot Mn(CO)_5$ to produce a species, probably $TcMn(CO)_{10}$. When still trapped in the $Mo(CO)_6$ lattice. it survives heating to 110°. (auth)

2564 METHOD OF MAKING PARTICLES FROM AN AQUEOUS SOL. Rankin, G. W.; Hooker, J. R. (to United States Atomic Energy Commission). US Patent 3,748,274. 24 Jul 1973. Filed Date 29 Aug 1969. 6p.

A process for preparing gel particles from an aqueous sol by forming the sol into droplets in a liquid system wherein the liquid phase contains a liquid organic solvent and a barrier agent. The barrier agent prevents dehydration from occurring too rapidly and permits surface tension effects to form sol droplets into the desired spheroidal shape. A preferred barrier agent is mineral oil. (Official Gazette)

2565 VIBRATION SPECTRA OF CRYSTALLINE SODIUM URANYL ACETATES. Caville, C.; Poulet, H.; Mathieu, J. P. (Univ., Paris). Bull. Soc. Fr. Miner. Crist.; 96: No. 1, 10-11 (Jan 1973). (In French).

The Raman spectra of single crystals of sodium uranyl acetate were obtained. In addition, the infrared spectrum of microcrystalline samples of this substance was measured. In this way, the symmetry of ground state vibrations were deduced together with the values of the three ground state frequencies of the UO_2^{2+} ion. (FR)

2566 ELECTRON SPIN RESONANCE STUDIES OF PARAMAGNETIC SPECIES FORMED ON IRRADIATING MUCOPOLYSACCHARIDES. Case of Sodium Heparinate. Baquey, C.; Darnez, C. (Institut National de la Sante et de la Recherche Medicale, Bordeaux). Compt. Rend., Ser. C; 277: No. 3, 139-142(16 Jul 1973). (In French).

Electron spin resonance studies of sodium heparinate exposed to γ radiation led to the establishment of a radical yield of about 1.5 which was independent of the irradiation temperature. In addition, the various modifications induced in the spectra recorded enabled the presence of at least two radical species to be confirmed. The ion radical, SO_3^-, is most probably included among these species. (FR)

Radioactive Waste Treatment

Refer also to abstract 4525.

2567 (ARH-2800) ENDOTHERMIC PROCESS: APPLICATION TO IMMOBILIZATION OF HANFORD IN-TANK SOLIDIFIED WASTE. Kupfer, M. J.; Schulz, W. W. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Jul 1973. Contract AT(45-1)-2130. 27p. Dep. NTIS $4.00.

Conversion of high-level solid radioactive waste to a nonleachable silicate glass is accomplished in the Endothermic process by simple melting of a mixture of the waste with crushed basalt. Dense (2.5 g cm^{-3}) green-black glasses are obtained by melting mixtures containing 30 to 40 wt% Hanford In-Tank Solidified (ITS) waste, 50 to 70 wt% basalt, and 0 to 10 wt% B_2O_3. Addition of B_2O_3 to the process charge is desirable to lower its melting range from about 1100−1150°C to 1000−1050°C. Leach rates of these glasses (calculated from the sum of the concentrations of Fe, Na, Ca, Si, Mg, Al, Sr, and Cs in the leach liquor) in water at 25°C range from 10^{-7} to 10^{-5} g/cm^2 day. The leach rate, based on ^{137}Cs, of a typical Endothermic process glass made from actual ITS waste, is 3.0×10^{-8} g/cm^2 day. This leach rate corresponds to removal of 2.1×10^{-14} g ^{137}Cs per day from a square centimeter of glass containing 57 μCi ^{137}Cs per gram. Judging from initial tests, the Endothermic process is a very promising scheme to increase immobilization of the ITS waste. (auth)

2568 (RFP-2016) FLUID BED INCINERATION OF RADIOACTIVE WASTES. Ziegler, D. L.; Johnson, A. J.; Meile, L. J. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 1973. 5p. (CONF-731101-18). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

A fluidized-bed incineration method of processing radioactive wastes was developed that has the following objectives: (1) to produce a nonrefractory plutonium oxide in the ash through the use of lower (500°C) operating temperatures; (2) to provide a system in which the corrosion of the incinerator and off-gas handling equipment is minimized through the use of in situ neutralization of acid gases generated in combustion of halogen containing materials; (3) to provide a system which would not require the use of refractory lined equipment because of lower operating temperatures in the reactor (500°C) and in the afterburner (600 to 750°C); and (4) to provide a system which would minimize the complexity of the off-gas cleaning equipment through the use of in situ neutralization of the HCl and the use of catalytic afterburning of the flue gas. (auth)

2569 HOLDING BACK OF KRYPTON BY ABSORBENT CARBON. Schumann, F. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 9: No. 1, 23-27(Jan 1973). (In German).

The increasing participation of atomic power stations in covering energy demand makes the problem of efficient retention of fission rare gases becoming more and more important. One of several possibilities to separate fission rare gases from the waste air of nuclear plants is based on the physical binding of these gases by surface-active materials passed by the homogeneous gaseous mixture to be separated. The efficiency of such a dynamic process depends on various parameters, such as temperature, gas pressure, partial pressure of the gas to be separated, flow rate of the carrier gas, composition of the carrier gas, grain size of the used material and, last not least, the geometry of the adsorption vessel. (auth)

2570 REMOVAL OF RADIOISOTOPES FROM WASTE SOLUTIONS. Kirby, H. W. (to United States Atomic Energy Commission). US Patent 3,764,553. 9 Oct 1973. Filed Date 18 Aug 1972. 6p.

The invention comprises removing radioisotopes from waste liquids or solutions by passing these through filters and through a column containing a suitable salt of phosphoric acid. (Official Gazette)

Radioisotope Production

Refer also to abstract 3678.

2571 (BNL-18214) NEW ACCELERATOR PRODUCED RADIOPHARMACEUTICALS. Richards, P.; Lebowitz, E. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 17p. (CONF-730944-4). Dep. NTIS $3.00.

From 11th international annual meeting of the German Society of Nuclear Medicine; Athens, Greece (24 Sep 1973).

The use of multi-purpose, high-current linear accelerators in the production of radionuclides for the development of new radiopharmaceuticals is discussed. A listing of pertinent information regarding the method of production, rate of production, expected yields, and potential application for ^{123}I, ^{52}Fe, ^{127}Xe, ^{201}Tl, ^{82}Rb, and ^{97}Ru is presented. (DHM)

2572 (CNEA-348) METHOD UTILIZED IN ARGENTINE FOR THE ROUTINE PRODUCTION OF CARRIER-FREE ^{131}I. Marques, R. O. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 15p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

A method for the routine production of carrier-free ^{131}I from reactor irradiated tellurium dioxide is described. The neutron-irradiated fraction: ^{130}Te(n, γ)^{131}Te β^- ^{131}I is dissolved in sodium hydroxide. The iodine oxysalts, which are present in the solution, are reduced to iodide with dextrose. By addition of silver nitrate solution the ^{131}I is precipitated together with silver oxide. The sedimentation of such precipitate followed by decantation allows the reduction of the initial volume by 90%. Residual sodium tellurite is oxidized to tellurate with ammonium persulfate and hydrogen peroxide, and the precipitate is dissolved with 10M sulfuric acid. The ^{131}I is then distilled and trapped in a sodium thiosulfate solution or in a sodium carbonate−bicarbonate buffer solution. The flowsheet of the method is given and the radiochemical purity control method is described. The ^{131}I obtained is used in medical research and therapy, labelling of organic compounds, etc. The yield is higher than 90% and the final product has an activity concentration between 40−100 mCi · ml^{-1} and a specific activity higher than 10 Ci · mg^{-1}. (auth)

2573 (EUR-5040) SEPARATION AND PURIFICATION OF AMERICIUM AND CURIUM ON THE MULTIGRAMME SCALE. Buijs, K.; Muller, W.; Reul, J.; Toussaint, J. C. (Commission of the European Communities, Karlsruhe (F.R. Germany). European Inst. for Transuranium Elements). Oct 1973. 38p. Dep. NTIS (U.S. Sales Only) $4.00. EUR B.Fr.50.-.

Experience obtained in separation and purification of transplutonium elements is discussed. During a five year period, different techniques, including precipitation, ion-exchange, and extraction chromatography, were applied to the purification of various gramme size samples containing ^{241}Am and also ^{242}Cm. These techniques were combined for the separation of 6 g of ^{244}Cm from 5 g of ^{243}Am, followed by the purification of each nuclide. The separation was carried out by precipitation of $K_3AmO_2(CO_3)_2$ from K_2CO_3 medium with ozone. Final purifications were achieved by extraction chromatography (Aliquat-336 and HDEHP), cation-exchange, and oxalate precipitation. (EU)

2574 (IRE-3/1973) AUTOMATIC APPARATUS FOR THE LIQUID−LIQUID EXTRACTION OF TECHNETIUM-99m. Charlier, R.; Fallais, C.; Constant, R. (Institut National des Radioelements, Brussels (Belgium)). Mar 1973. 26p. (In French). Dep. NTIS (U. S. Sales Only) $3.50.

In the production of ^{99m}Tc the separation of ^{99}Mo−^{99m}Tc is generally achieved by means of a chromatographic column called "isotopic generator." A study is reported of another separation process, liquid-liquid extraction. This represents the advantage of resultant volumic activities being higher than by means of the conventional generator, with a lower cost price. However, in order that this process might compete with the classic generator, which is very easy to use, it is indispensable that the user has at his disposal completely automatic equipment. It is with this in view that the extractor being presented has been constructed. The results obtained for the trials carried out are presented and discussed. Some parameters influencing the extraction yield as well as the quality of the final product are shown. (auth)

2575 (JINR-P12-7164) FAST GAS-THERMOCHROMATOGRAPHIC METHODS OF RADIOACTIVE ELEMENT EXTRACTION. II. Gold as Universal Target for Rapid Production of Radioactive Samples of Rhenium, Osmium, Iridium, and Mercury.

Bayar, B.; Votsilka, I.; Zaitseva, N. G.; Novgorodov, A. F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The behavior of ultramicroquantities of volatile oxides of Re, Os, Ir, and Hg is studied during evaporation in a flow of oxygen, air, and helium from a gold melt that is bombarded with the protons having E = 660 MeV. It is shown that, when the mixture of gaseous products is passing along the thermochromatographic quartz column, having a negative temperature gradient, the volatile oxides precipitate (with a temperature decrease) in different zones in the order: Re, Ir, Hg, and Os. The mechanism of production and the behavior of these oxides in the processes of their evaporation from the melt of bombarded gold and precipitation on the tube walls are studied. Based on the data obtained a fast gas-thermochromatographic method is suggested for the production of radioactive samples of Re, Os, Ir and Hg from the bombarded gold. (auth)

2576 EFFECTIVE, ROUTINE REACTOR PRODUCTION METHOD OF ^{18}F FOR MEDICAL USE. Helus, F.; Krauss, O.; Maier-Borst, W. (Inst. of Nuclear Medicine, Heidelberg). Radiochem. Radioanal. Lett.; 15: No. 3, 225-230(20 Oct 1973).

An effective and rapid method for the reactor production of ^{18}F for medical use is described. The ^{18}F is produced by neutron irradiation of enriched lithium carbonate and is separated by the distillation procedure. The chemical yield at the end of the separation procedure is better than 95%. About 15 to 20 mCi of carrier-free ^{18}F can be delivered 25 to 30 minutes after a 3 to 4 hour irradiation. (auth)

2577 RAPID GAS-THERMOCHROMATOGRAPHIC SEPARATION OF RADIOACTIVE ELEMENTS. I. Production of Radioactive Re Isotopes. Bayar, B.; Novgorodov, A. F.; Zaitseva, N. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Radiochem. Radioanal. Lett.; 15: No. 3, 231-242(20 Oct 1973).

By means of the radioactive indicator method the gas-thermochromatographic behavior of Re at the thermal decomposition of NH_4ReO_4 crystals and Os_{met}. burning up and its dependence on a number of factors such as temperature, time of sublimation, carrier-gas flow rate were studied. The dependence of the temperature on the condensation of volatile Re compound upon Re concentration and water vapor content in the sample was observed. On the basis of the obtained results a method for the fast production of radioactive Re samples from NH_4ReO_4 and Os_{met}. irradiated with 660 MeV protons was developed. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 2433, 2596, and 3147.

2578 (BARC-672) DEVELOPMENT OF AIR PULSED MIXER SETTLER EQUIPMENTS FOR SOLVENT EXTRACTION STUDIES. Srinivasan, N.; Nadkarni, M. N.; Balasubramanian, G. R.; Ramanujam, A.; Venkatesan, M.; Gopalakrishnan, V. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

Mixer–settlers of two capacities 100 ml/min and 10 ml/min were developed, using air pulsing as mixing device and air lift for interstage fluid transfer. The units were made of glass and battery assembled with PVC tubings. The studies were carried out using uranium–TBP system in two stage battery. The influence of type of pulsing probe used, and amplitude and frequency of the pulsing used were studied. Influence of type of dispersion on efficiency and entrainment was also studied. The residence time in mixer was fixed by batch mixing experiments. (auth)

2579 (BARC-673) LABORATORY COUNTER CURRENT EXTRACTION AND STRIPPING STUDIES IN AIR PULSED MIXER SETTLER BATTERY FOR HIGH PLUTONIUM CONCENTRATIONS. Srinivasan, N.; Nadkarni, M. N.; Balasubramanian, G. R.; Ramanujam, A.; Venkatesan, M.; Gopalakrishnan, V. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 27p. Dep. NTIS (U. S. Sales Only) $3.50.

The proposed fuel for the Indian fast breeder test reactor is mixed oxide of 70% U and 30% Pu with 85% enriched U content. From available data in literature and experiments conducted here, a flow sheet consisting of the three cycles, each cycle consisting of an extraction and stripping step, is planned. Counter current runs were conducted under feed conditions without fission products similar to that anticipated in fast reactor fuel reprocessing, in a battery of 16 stage air pulsed mixer settler. Graphs include stage wise concentration of U and Pu in each phase, for all runs. In all runs Pu loss was less than 0.1%. (auth)

2580 (BLG-478) PRELIMINARY TECHNICAL AND ECONOMICAL EVALUATION. Heylen, P. R.; Wurm, J. G.; Etienne, J. C.; Lecerf, H.; Rombaux, J. P.; Van Impe, J.; De Beukelaer, R.; Dubois, G.; Glibert, R. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium); Societe Belge pour l'Industrie Nucleaire, Brussels). Mar 1973. 48p. (In French). Dep. NTIS (U. S. Sales Only) $4.50.

A technico-economical evaluation has been realized in order to choose a flow-sheet for the reprocessing of fast breeder fuels. To be in a position to orient more efficiently the research and development work related to a pilot installation, six transport and head-end alternatives for a reprocessing plant with a capacity of 1 t/day after 150 days cooling, based on the Purex process, have been compared. For each of these alternatives, the advantages and disadvantages, investments, annual functioning costs and respective costs of the reprocessing per kg (UO_2, PuO_2) have been evaluated, excluding Purex extraction and waste storage. For a plant having this capacity, a pyrochemical head-end comprising sodium deactivation by molten salts, transport under molten salts, mechanical chopping of complete assemblies, disaggregation under molten salts followed by solution in diluted nitric acid, would present the advantage of lowering the investment by 25% and the cost price by 40%, compared to a plant of the same capacity using the present techniques for disassembly and individualization of the pins on the reactor site, transport under gas, chopping, voloxidation and dissolution in (HNO_3, HF). Next to the economical interest of this head-end, the study revealed various important advantages related to security and environment. The costs for transport and reprocessing by molten salts, excluding Purex extraction, would amount to 3268 FB(1972) per kg (UO_2, PuO_2). (auth)

2581 (DOCKET-50332-36) BARNWELL NUCLEAR FUEL PLANT. Effect of a Tornado on Absolute Filters. (Allied Gulf Nuclear Services, Barnwell, S. C. (USA)). 18 Sep 1973. 5p. Dep. NTIS $3.00.

Results are reported for studies on the effects of tornado depressurization on the final HEPA filters of the Barnwell Nuclear Fuel Plant. It is concluded that the filters will remain operable during a tornado depressurization provided they are changed as planned before the pressure drop exceeds a total of 6″ W. G. (1″ clean and 5″ dirt loading) under normal operating conditions. (JGB)

2582 (EUR-5010) REPROCESSING OF FAST BREEDER REACTOR FUEL USING AQUEOUS REPROCESSING TECHNOLOGY. Callerl, G.; Detilleux, E.; De Beukelaer, R.; De Coninck, A.; Van Caeneghem, J.; Valentini, G.; Zifferero, M. (Commission of the European Communities, Brussels (Belgium)). 2 Apr 1973. 54p. Dep. NTIS (U. S. Sales Only) $4.75. EUR B.Fr. 60.-.

The report is meant to be an inventory of the most important problems which will be encountered during the processing of fast breeder reactor fuels using aqueous reprocessing technique. It has been the objective to analyze the origin of the different problems and establish their importance in comparison with the actual practice in processing light water reactor fuels. As a basis for the analysis and comparison, light water reactor fuels with a burn-up of 30,000 Mwd/ton and fast breeder core fuel of 80,000 Mwd/ton burn-up have been chosen. The reactor Na-1 on which information and calculated provisional data were readily available has been used as a specific example. The annexes to the report contain detailed figures on fuel characteristics used in the study. (auth)

2583 (HEDL-TME-73-51) EFFECT OF HIGH SOLVENT RADIATION EXPOSURES ON TBP PROCESSING OF SPENT LMFBR FUELS. Richardson, G. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1973. Contract AT(45-1)-2170. 134p. Dep. NTIS $5.45.

The results of laboratory experiments with miniature, multistage contactors showed that tri-n-butyl phosphate (TBP) can be used satisfactorily to process high burnup, short-cooled LMFBR fuels at solvent radiation exposures up to and including 0.5 W-hr/l per pass, the probable maximum exposure for pulse column processing of LMFBR fuel. No further adverse effects were found for cumulative cyclic exposure of over 45 W-hr/l. The major adverse effects of high solvent radiation exposures (ca. 2 W-hr/l) were an approximately 10 to 30-fold decrease in the ^{95}Zr and ^{95}Nb decontamination factors to the uranium and plutonium aqueous product streams and an approximately 200 to 500-fold increase in the uranium loss to the stripped solvent (0.02 to 0.04% of the uranium in the solvent entering the contractor). Flowsheet conditions were developed for restoring the fission product decontamination performance at high radiation doses. (auth)

2584 (JUL-968-CT) DETERMINATION OF CALIBRATION FUNCTIONS FOR THE IN-LINE ANALYSIS OF URANIUM AND THORIUM IN SEVERAL PROCESS FLOWS OF THE REPROCESSING PILOT PLANT JUPITER. Brodda, B. G. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Chemische Technologie). Jun 1973. 35p. (In German). Dep. NTIS (U.S. Sales Only) $3.75.

In the operation of the JUPITER plant, a series of process flows must be in-line checked for the operational control regarding their heavy metal content. The investigations on simulated process solutions have shown that for all flows of interest, sufficiently accurate values can be obtained merely from density and temperature measurements. An additional determination of conductivity is certainly not necessary. The evaluation of the measured values for density and temperature can be obtained by applying an equation whose coefficients are given in tabular form for the various types of process flows. (orig./LH) (GE)

2585 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL PROCESSING. Anderson, R. N.; Parlee, N. A. British Patent 1,323,474. 18 Jul 1973. Filed date 13 Nov 1970. 6p.

A process is described for separating U from Pu and fission products that is claimed to have advantages over previous methods. The fuel is dissolved in a molten metal solvent that does not readily form nitrides and the solution is subjected to nitrification at temperatures and nitrogen pressures such that the U is precipitated out in the form of nitride. After removing the uranium nitride the residual molten metal solution is heated to distill the molten metal from residual Pu. The residual molten metal solution may also be subjected to nitrification under appropriate conditions to precipitate residual Pu as nitride, together with any residual U. Fission products remain in the molten metal solution. The molten metal solvent may be Sn, and the nitriding step is conducted in a graphite vessel. The separated uranium nitride may be converted to U metal or to oxide. (UK)

2586 IRRADIATED FUEL PROCESSING SYSTEM. Kendall, W. R. (to General Electric Co.). Canadian Patent 905,838. 25 Jul 1972. vp.

A system is described for the mechanical preparation of irradiated fuel bundles containing useful amounts of residual fissionable fuel material and retaining valuable fission products, for chemical reprocessing. The system permits improved handling, disassembling, and shearing of fuel bundles, and shearing of fuel rods, and lends itself to either manual or automatic operation and convenient repair and replacement of worn parts. Fuel bundles are first clamped on a clamp table and the fuel rod ends removed. A fuel rod pulling head pulls individual fuel rods or groups of fuel rods from the bundle. A holding table collects the desired number of fuel rods, then directs them to a shear feed means. The shear feed means feeds groups of fuel rods incrementally into a double-blade shear which cuts the rods into small pieces which fall into a container for chemical reprocessing of the fuel. (CA)

ENGINEERING

Energy Conversion

Refer also to abstract 4316.

2587 (CEA-R-4508) ELECTRON EMISSION EXPERIMENTAL STUDY OF A (100) TUNGSTEN SINGLE CRYSTAL COVERED WITH CESIUM AND OXYGEN. Denisot, J. L. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). Oct 1973. 51p. (In French). Dep. NTIS (U. S. Sales Only) $4.75.

This study was made within the framework of thermionic converter electrode research. The converter efficiency was appreciably increased by oxygen additions. The cesium-oxygen (100) tungsten experiments were carried out by means of a thermionic electron emission microscope. In this device, the tungsten sample is exposed to two independent fluxes of cesium and oxygen. The experimental results are shown in the form of curves plotted on the one hand with emitted electron current and temperature, and on the other hand with work function and tungsten temperature over cesium temperature ratio. The oxygen partial pressure can reach some 10^{-6} torr; the cesium temperatures being 315, 330 and 348°K. The oxygen addition generally leads to a large decrease in Cs-W work function. The minimum attainable work function was found to be about 1 eV. (auth)

2588 POTENTIAL DISTRIBUTION IN A TWO-GAS THERMIONIC CONVERTER AT CURRENT SATURATION. Babanin, V. I.; Mustafaev, A. S.; Sitnov, V. I.; Ender, A. Ya. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys. Tech. Phys. (Engl. Transl.); 17: No. 10, 1695-1700(Apr 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 10, 2144-2152(Oct 1972).

An investigation of a Knudsen thermionic converter with two gases reveals new means of investigating the potential distribution. The relationship between the saturation current in a thermionic converter and the degree of compensation is examined. The shape of this function indicates whether the potential well is filled with ions. Experiments with a thermionic converter filled with a Cs-Ba mixture show that in the undercompensated regime the potential well is not filled with ions. (auth)

2589 ANALYTIC MODEL OF THE ARC REGIME AND OPTIMIZATION OF THERMIONIC CONVERTERS. Loshkarev, A. I. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 10, 1684-1690(Apr 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 10, 2127-2136(Oct 1972).

A low-voltage arc model is considered under the assumption that the temperatures of all the particles in the electrode gap are the same: The model takes account of volume ionization and recombination. If there are potential discontinuities that inhibit the electrons at the electrodes, homogeneous boundary conditions can be used with a high degree of accuracy. In this case the integrals of the transport equations are expressed in terms of elliptic functions, and their characteristics can be calculated by using a system of simple analytic expressions. The ionization state of the plasma is determined by a single parameter δ that depends exponentially on the electron temperature. The influence of the gradient of the electron temperature is analyzed. It is shown that the mean plasma parameters are characterized by an average electron temperature, and that the output parameters can be calculated from relations that are valid for a model in which the particle temperature is constant over the gap. An approximate method is proposed for constructing the voltage-current characteristic. The method takes account of the possible formation of a virtual cathode and yields good agreement with the appropriate experimental data. The optimum work function of the cathode and the optimum neutral density needed to ensure maximum output power are given as functions of the cathode temperature and the gap for the arc and gas-kinetic regimes. The arc regime is superior to the gas-kinetic regime in the range of useful cathode temperatures. The influence of addition of the inert gas is analyzed and conditions are indicated under which addition of an inert gas can lead to higher output. Optimum working conditions can be produced in the converter more effectively by raising the cesium pressure than by adding inert gas. (auth)

2590 MEASUREMENT OF VOLT-AMPERE CHARACTERISTICS OF THERMIONIC CONVERTERS USING BIPOLAR PULSES HAVING A HIGH-DUTY RATIO. Igumnov, B. N.; Evilin, V. P.; Murguliya, V. D. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 802-803(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 126-127(1973).

A circuit based on thyristors is described for obtaining the volt-ampere characteristics (v.a.c.) of thermionic converters on an S1-18 oscilloscope using separately controlled bipolar sweep pulses. The range of currents that can be taken off extends up to 2 kA. In order to increase the measurement, accuracy calibration of the oscillograms by means of dc instruments is provided. (auth)

Facilities and Equipment

Refer also to abstracts 3146, 4736-4738, 4746, and 4755.

2591 (AECL-4514) EXPERIMENTAL STUDIES ON FLOW INDUCED VIBRATION TO SUPPORT STEAM GENERATOR DESIGN. Part I. Vibration of a Heated Cylinder in Two-Phase Axial Flow. Pettigrew, M. J.; Gorman, D. J. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). May 1973. 14p. (CONF-730465-1). Dep. NTIS (U. S. Sales Only) $3.00.

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

An exploratory vibration experiment on a heated cylinder in axial flow was conducted in a steam/water test loop. Vibration measurements were taken under various flow conditions while steam was either added at the inlet of the test section or generated by the heated cylinder. The contribution of subcooled and bulk nucleate boiling noise to vibration amplitude was investigated. The effects of other flow parameters such as pressure, mass flux and steam quality were also studied. The results show that the vibration response appears highly dependent on flow regime. Nucleate boiling noise did not cause excessive vibrations in this experiment. (auth)

2592 (AECL-4515) EXPERIMENTAL STUDIES ON FLOW INDUCED VIBRATION TO SUPPORT STEAM GENERATOR DESIGN. Part II. Tube Vibration Induced by Liquid Cross-Flow in the Entrance Region of a Steam Generator. Pettigrew, M. J.; Platten, J. L.; Sylvestre, Y. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). May 1973. 18p. (CONF-730465-2). Dep. NTIS (U. S. Sales Only) $3.00.

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

At the entrance to the tube bundle of recirculating type steam generators, tube vibrations may be induced by cross-flow. The results of an experimental vibration study on a full size model of a 30° sector of the lower region of a steam generator under realistic flow conditions are reported. The vibration response of the tubes and in particular the nature of the flow-induced excitation forces were investigated. Tube vibration amplitudes under normal operating Bruce steam generator flow conditions were generally less than 0.001 in. rms. Thus, no vibration problems are anticipated there. The flow-induced excitation forces appear to be broad-band random in nature. The vibration response is directly related to a power of the flow velocity. (auth)

2593 (LMEC-73-5) CAVITATION CHARACTERISTICS OF 18 INCH BUTTERFLY VALVE FOR SODIUM PUMP TEST FACILITY (SPTF). Cho, S. M.; Carlson, W. J.; Tessier, M. J. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 15 Jun 1973. Contract AT(04-3)-700. 59p. AT.

An 18-in. butterfly valve with a symmetrical valve disk was tested in water to determine the incipient cavitation indexes as a function of the valve opening angle. The results, when compared with other experimental data obtained for butterfly valves, show, in general, reasonable agreement at lower valve angles (or discharge coefficient) but increasing discrepancy with an increasing valve angle. The upstream pressure effect that has been experimentally observed recently in other tests was indicated, but was not quantitatively evaluated because of system limitation. The effects of different fluids, water versus sodium, on the incipient cavitation index and cavitation damage are discussed. The cavitation information obtained in the water test was extended to geometrically similar butterfly valves for use in a high-temperature liquid sodium system (Sodium Pump Test Facility), followed by an optimization study of the sodium flow loop minimizing cavitation. (auth)

2594 TESTING AND CHECKING OF HOT-STEAM COMPONENTS. Rump, G. (Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein eV, Essen). Tech. Ueberwach.; 14: No. 9, 249-254(1973). (In German).

As the possible life time of a hot-steam component designed for long-term operation varies considerably due to the deviating time-to-rupture of the material and the possible wall thickness tolerances, a simplified process has been suggested due to the reduced accuracy of the measured values. Using this method, the requirements of both personnel and material in the determination of the time-to-rupture behavior of hot-steam components can be reduced. As a consequence of the unsatisfactory accuracy arising from the given tolerances, the study of the remaining stresses should be given precedence over the time-to-rupture tests, as regardless of the measured rupture times, a hot-steam component has to be replaced as soon as it cracks or permanent stresses above 2% have been detected. One should, therefore, concentrate on the detection of weak points in the material during operation. Hence the hot-steam components should be continuously checked for permanent stresses in order to determine the possible breaking time. (GE)

2595 THERMOELASTIC STRESSES DUE TO LOCALISED SPACE- AND TIME-DEPENDENT TEMPERATURE OF HEAT TRANSFER PERTURBATION. Holy, Z. J. pp 190-197 of Conference on Stress and Strain in Engineering. Sydney; Institution of Engineers (1973).

From conference on stress and strain in engineering; Brisbane, Australia (23 Aug 1973).

Applying linear thermoelasticity and assuming constant material properties, analytical methods are outlined and discussed for the solution of stresses due to localized time- and space-variable temperature or heat transfer coefficient over the surface of an infinite half space. Essentially, both the axisymmetric static and time-dependent problems reduce to the determination of the coefficients in Laguerre polynomial expansions of the surface temperature. By the thermal version of St. Venant's principle, any method developed for the half-space would be applicable, as an approximation to any sufficiently localized axisymmetric variation on any other type of body such as a cylinder. It is concluded that significant stress increases can occur and must be taken into account in the design of components subject to surface heat transfer or temperature variation. (auth)

2596 HIGH-CAPACITY ANNULAR CENTRIFUGAL CONTACTOR. Bernstein, G. J.; Grosvenor, D. E.; Lenc, J. F.; Levitz, N. M. (Argonne National Lab., Ill.) Nucl. Technol.; 20: No. 3, 200-202(Dec 1973).

A centrifugal contactor of unique design has been developed for solvent extraction processing of high-plutonium-content fuels. The unit has a vertically suspended rotor that has a 4-in. inside dia and is 15 in. long (with a 12-in.-long separating zone). Aqueous and organic phases are fed into the annulus between the contactor casing and the spinning rotor and are mixed by skin friction. The mixture flows down the annulus and then up through an orifice in the bottom of the rotor. The phases are separated by centrifugal force as they flow up the inside of the rotor and are discharged at the top. Separating capacities (throughput) ranged from 4.5 gal/min at 2000 rpm to 15 gal/min at 3500 rpm. Essentially 100% stage efficiency was demonstrated in extraction and stripping of uranium between nitric acid and 30% tri-n-butyl phosphate in n-dodecane diluent. The basic annular-mixer design is suitable for contactors with larger or smaller diameters. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 2591, 2592, 2631, 2645, 2799, 4457, 4586, 4708, 4720, 4757, 4772, and 4775.

2597 (AERE-R-7519) POST DRYOUT HEAT TRANSFER IN NUCLEAR AND CRYOGENIC EQUIPMENT. Bailey, N. A.; Collier, J. G.; Ralph, J. C. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Aug 1973. 36p. Dep. NTIS (U. S. Sales Only) $4.00.

Heat transfer in the liquid deficient region downstream of the dryout location is considered in relation to the performance of steam generating reactors, once-through steam generators, and cryogenic vaporizers. Experimental results are reported on the propagation of dryout for vertical electrically heated tubes of 12.7 mm (0.5") bore with both uniform and cosine heat flux profiles by up-flow of steam-water mixtures at pressures up to 70 bar (1000 psia). Measurements are given of local wall temperatures as dryout proceeds with increasing power increments. A semi-empirical model of the liquid deficient region has been found to give reasonable agreement with experimental results. This model divides the heat transfer mechanism into two processes; heat transfer from the wall to a superheated boundary layer and evaporation of entrained droplets in the superheated vapour core assuming no droplet/wall interaction. Tests on a vertical electrically heated U-tube test section 12.8 mm (0.504") bore and 12.2 m (40 ft) total length carried out at a steam pressure of 180 bars (2600 psia) are discussed. Measurements were made of wall temperatures downstream of dryout. The data are compared with existing correlations and analyzed in an attempt to separate the components of droplet deposition and forced convection in the liquid deficient region as droplet/wall interaction was then significant. A method is proposed whereby the water-side heat transfer characteristics determined using electrically heated tubes may be used to estimate the variation in tube wall temperatures in a sodium-heated steam generator. Analysis of some published data for cryogenic fluids indicates a similar behavior to that for water. Wall temperatures computed from the semi-empirical model development for water systems show moderate agreement with these published experimental profiles. (auth)

2598 (CEA-R-4482) CLASS OF SOLUTIONS FOR PLANE COMPRESSIBLE FLOW WITH RADIATIVE TRANSFER. Bajac, J. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint Georges (France)). Oct 1973. 39p. (In French). Dep. NTIS (U. S. Sales Only) $4.00.

Thesis.

The self similar solution is studied that describes the motion of an infinite half space for initially uniform density and zero temperature and for a boundary temperature which is proportional to a power of the time. The effect of the radiation field is considered. All computed solutions possess an isothermal shock. The continuous solutions mentioned by Marshak were not obtained. An interesting feature of the problem is that two distinct solutions pertaining to a given gas may coincide throughout a whole interval of the precursor. (auth)

2599 (DP-1319) HEAT TRANSFER LABORATORY OF THE SAVANNAH RIVER LABORATORY. Knoebel, D. H.; Harris, S. D. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Oct 1973. Contract AT(07-2)-1. 24p. Dep. NTIS $4.00.

The Heat Transfer Laboratory, recently constructed adjacent to the main Savannah River Laboratory building, was designed to mock up nuclear heating and cooling of reactor components under a variety of conditions. Nuclear heating is simulated by electrical resistance heating of test sections with a 3 MW direct-current power supply. Cooling is provided by water. Three test stations (A, B, and C) are available for testing full-size fuel assemblies, measuring flow instabilities, and for measuring burnout heat fluxes. Safeguards provided in the design of the facility and conservative operating procedures minimize or eliminate potential hazards. (auth)

2600 (K-1847) PERFORMANCE OF COMPACT HEAT TRANSFER SURFACES: FINNED AND BARE TUBE BANKS. Cox, B. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 42p. Dep. NTIS $5.45.

Heat transfer and flow friction characteristics were determined experimentally for seven high-finned tube banks. A variety of fin types were represented: plate fins, integral smooth helical fins, integral serrated fins, and helical serrated fins. The experimental data results plus data from the open literature are used to determine the effects that tube pitch has on tube bank performance. (auth)

2601 (TUBIK-25) ANALYTICAL SOLUTIONS FOR THE VELOCITY FIELDS IN LONGITUDINAL LAMINAR FLOW IN FINITE ROD BUNDLES OF ARBITRARY ARRANGEMENT. Mottaghian, R. (Technische Univ. Berlin (F. R. Germany). Inst. fuer Kerntechnik). Jul 1973. 135p. (In German). Dep. NTIS (U. S. Sales Only) $8.75.

Thesis.

An analytical method for calculating of fully developed, longitudinal laminar flow in finite rod bundles with more than one ring of rods of arbitrary arrangement is presented. Two-dimensional velocity fields, local wall shear stress distributions, pressure drops, and total friction factors are given as functions of rod arrangement, radial displacement of rod rings, pitch-to-diameter ratio, tube wall spacing, number of rods, and number of rod rings. (auth)

2602 RADIATIVE HEAT TRANSFER BY SOLID SUSPENSION TURBULENT FLOW WITH RADIATING FLUID IN A CIRCULAR TUBE WITH CONSTANT WALL TEMPERATURE. Echigo, R. (Kyushu Univ., Fukuoka); Hasegawa, S.; Takechi, E.; Okamoto, Y. Nippon Genshiryoku Gakkaishi; 15: No. 8, 557-561(Aug 1973). (In Japanese).

While a solid suspension medium acquires superior heat transfer characteristics under the condition of high temperature and high heat flux such as encountered with the HTGR, a clear knowledge of the heat transfer mechanism and the quantitative evaluation of heat transfer seem to be insufficient. An analysis was performed on the heat transfer by a turbulent flow of radiating gaseous suspension in a circular tube with constant wall temperature, taking account of the thermal radiation to both particulate and carrier phases simultaneously. The complexities of the geometry and the flow mechanics are described by introducing plausible assumptions. The results reveal greatly improved heat transfer on account not only of the increased heat capacity of the flowing medium but also of the enhanced radiative heat transfer caused by the increment of the optical thickness for radiation. The results obtained here are also compared with those of a single phase flow of radiating medium, and a simplified treatment of heat transfer by gaseous suspension flow is presented to facilitate practical calculations. (auth)

Materials Testing

Refer also to abstracts 2673 and 3050.

2603 (CEA-CONF-2427) DIFFERENT ASPECTS AND EXPERIMENTAL RESULTS OF EDDY CURRENT TESTING USING THE FREQUENCY SCANNING METHOD. DuJardin, R.; Samoel, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles). 7 Feb 1973. 10p. (In French). (CONF-730606-6). Dep. NTIS (U. S. Sales Only) $3.00.

From seventh international conference and exhibition on nondestructive testing; Warsaw, Poland (4 Jun 1973).

Frequency scanning methods that enable eddy current tests to be performed at any given part of the frequency spectrum are described. This method permits sharp selectivity while discriminating between different types of defects. The use of test and probe coils, designed following optimal performance criteria, ensures good sensitivity. Recordings of defects of different types and sizes, found in small diameter metal tubes, made at different frequencies, are shown. (TFD)

2604 (CONF-730324-, pp 9-10) STROBOSCOPIC NEUTRON RADIOGRAPHY. Godfrey, S.; Raczkowski, R. (Univ. of Toronto). 1973.

From ANS Niagara—Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

2605 (HEDL-TME-73-71) PERFORMANCE OF COMPOSITE INTENSIFYING SCREENS FOR RADIOGRAPHY IN THE NUCLEAR FIELD. Gray, W. H.; Jackson, C. N. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1973. Contract AT(45-1)-2170. 48p. Dep. NTIS $4.00.

A performance evaluation indicated that a composite intensifying screen for radiography can achieve significant economics by reducing the exposure time of kilovoltage needed. For many applications, the radiographic quality can match code requirements. The resolution capability was determined by penetrameter sensitivity, as described in ASTM E 142-68, "Standard Method for Controlling Quality of Radiographic Testing." This standard is cited in important American codes for the nuclear field such as ASME Boiler and Pressure Vessel Codes Section III; Nuclear Power Plant Components and RDT F3-6T, Non-destructive Testing (US-AEC, Division of Reactor Development and Technology). The evaluation was conducted using stainless steel samples that spanned a thickness range from ½ to 5 inches. Radiation quality covered a range from 200 kV x-ray to approximately 1.25 MeV (industrial isotope ^{60}Co) investigated in conjunction with four types of widely used American industrial radiographic film. The composite screens designed for "high speed" exhibited resolving capability nearly equal to conventional lead foil intensifying screens when examining steel ⅝ inch or thicker. In this range, they achieved radiographic quality of 2-2T or better, as described in ASTM E 142-68. (auth)

2606 (INIS-mf-654, pp 63-71) BASIC CHARACTERISTICS OF A NEW 22-MeV BETATRON FOR NONDESTRUCTIVE TESTING. Rytina, K. (Inst. of Plasma Physics, Prague). Oct 1971. (In Czech.).

Some of the characteristics of a betatron having a maximum energy of 22 MeV are presented. The basic research on the betatron was completed by the Institute of Plasma Physics, and the apparatus is to be manufactured by the Mechanization and Automation Division, Czechoslovak Uranium Industry, Ostrov nad Ohri. The betatron was designed for the inspection of steel objects of 100 to 400 mm in thickness. The selected magnetic field parameters and the chamber cross-section permit attaining radiation intensities of 300 to 400 μW/cm^2 at a distance of 1 m from the target. (INIS)

2607 (INIS-mf-654, pp 97-118) NEUTRON RADIOGRAPHY AND POSSIBLE APPLICATIONS IN CZECHOSLOVAKIA. Hrdlicka, Z. (Inst. of Nuclear Research, Rez, Czech.). Oct 1971. (In Czech.).

A brief review is presented of the principle and the specific properties of neutron radiography. The selection of a neutron source, the neutron energy, and suitable applications are discussed. The possibilities and the prospects of applying neutron radiography in Czechoslovakia are discussed (the VVR-S experimental reactor with a thermal output of up to 4 MW is used as a neutron source). (INIS)

2608 (INIS-mf-654, pp 119-129) RADIATION SOURCES USED IN NONDESTRUCTIVE TESTING IN CZECHOSLOVAKIA. Vondruska, V. (Inst. for Research, Production, and Uses of Radioisotopes, Prague). Oct 1971. (In Czech.).

A survey is given of sealed radiation sources used in Czechoslovakia, listed by suppliers (^{60}Co, ^{137}Cs, and ^{192}Ir) activities, and by the size and the type of case. (INIS)

2609 (RT/ING-(73)3) EXPERIMENTAL FACILITY FOR VIBRATIONS AND FRETTING CORROSION TESTS. Avitabile, M.; Cumo, M.; Palmieri, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 30 May 1973. 36p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.00.

The meaning of vibration and fretting corrosion tests for prototypes of nuclear fuel elements is described as well as the flow diagram and the main components of the experimental facility with which the tests are performed. The experimental facility was built at the Laboratorio Tecnologie Reattori of the CNEN and has been operated for vibration and fretting corrosion tests. Further possibilities of the facility as well as the present version are compared and discussed. (auth)

2610 OBTAINABLE RADIOGRAPHIC EQUIVALENT PENETRAMETER SENSITIVITY. Splettstosser, H. R. (Eastman Kodak Co., Rochester, NY). J. Test. Eval.; 1: No. 4, 336-340 (Jul 1973).

Some of the properties of film and vision which affect radiographic sensitivity are discussed. Values of obtainable equivalent penetrameter sensitivity are given for some practical conditions when radiographing ¼-to 2-in.-thick steel with x-rays and 1- to 6-in. -thick steel with ^{60}Co. Limitations to calculations of sensitivity for other conditions are given based on these results. (auth)

Nuclear Explosions

Refer also to abstract 2648.

2611 (BMVg-FBWT-71-2) ABM SYSTEMS: NUCLEAR PHYSICS ASPECTS. Leuthaeuser, K. D.; Roose, U. J. (comps.). (Bundesministerium fuer Verteidigung, Bonn (F. R. Germany). Abt. Wehrtechnik). 1971. 23p. (In German). INIS.

The nuclear physics aspects of high-altitude nuclear explosions were investigated with respect to the qualification as ABM-systems. An aggressive nuclear weapon system will be damaged by a defensive nuclear burst in its proximity. In discussing the efficiency of each damage mechanism the following effects on offensive nuclear weapon systems have to be considered: (1) influence of nuclear radiation (gamma rays and neutrons) on electronics and the nuclear device, and (2) mechanical damage caused by thermal radiation and the expansion of the fireball. The corresponding destruction radii are estimated. An upper limit of some kilometers seems to be reasonable for the most relevant damage mechanisms. (INIS)

2612 (EERL-TR-E-73-4) SEISMIC REFRACTION EXPLORATION FOR ENGINEERING SITE INVESTIGATIONS. Redpath, B. B. (Army Engineer Waterways Experiment Station, Livermore, Calif. (USA). Explosive Excavation Research Lab.). May 1973. 60p. Dep. NTIS $5.45.

The theory and practice of using the refraction seismograph for shallow, subsurface investigations is summarized. This is intended to be a guide to the application of the technique and not a comprehensive analysis of every aspect of the method. The fundamentals are presented and their use in time-intercept calculations and interpretations using delay times are discussed. The limitations of this exploration tool are discussed, and other applications of the equipment, such as uphole surveys, are described. Field procedures for carrying out refraction surveys are also recommended. (auth)

2613 (JAB-99-98) RESPONSE OF TWO IDENTICAL SEVEN STORY STRUCTURES TO THE SAN FERNANDO EARTHQUAKE OF FEBRUARY 9, 1971. Freeman, S. A.; Honda, K. K. (Blume (John A.) and Associates Research Div., San Francisco, Calif. (USA)). Oct 1973. Contract AT(26-1)-99. 70p. Dep. NTIS $5.45.

The results of the structural dynamic investigation of two seven-story reinforced concrete frame structures are presented here.

The structures are both Holiday Inn motor hotels that are essentially identical: one is located about 13 miles and the other about 26 miles from the epicenter of the February 9, 1971, San Fernando earthquake. Appreciable nonstructural damage as well as some structural damage was observed. Strong-motion seismic records were obtained for the roof, intermediate story, and ground floor of each structure. The analyses are based on data from the structural drawings, architectural drawings, photographs, engineering reports, and seismogram records obtained before, during, and after the San Fernando earthquake. Both structures experienced motion well beyond the limits of the building code design criteria. A change in fundamental period was observed for each structure after several seconds of response to the earthquake, which indicated nonlinear response. The analyses indicated that the elastic capacity of some structural members was exceeded. Idealized linear models were constructed to approximate response at various time segments. A method for approximating the nonlinear response of each structure is presented. The effects of nonstructural elements, yielding beams, and column capacities are illustrated. Comparisons of the two buildings are made for ductility factors, dynamic response characteristics, and damage. Conclusions are drawn concerning the effects of the earthquake on the structures and the future capacities of the structures. (auth)

2614 (PNE-R-65) INVESTIGATION OF RULISON RADIOACTIVITY. Johnson, B.; Jessen, P.; Bergamo, F. (Kaman Sciences Corp., Colorado Springs, Colo. (USA)). 1971. 20p. Dep. NTIS $3.00.

On October 25, 1971, six months after the cessation of test flaring, the immediate inhabited area around the Rulison site was monitored by making wipe tests of oily surfaces, and by checking the radioactivity of water samples. Over 70 different wipe tests and water samples were taken at more than 60 locations. None of these samples showed any detectable radioactivity; i.e., levels significantly higher than background radioactivity. These natural background levels are at least a factor of 100 below the level considered safe by the AEC and by the International Committee on Radiation Protection for uncontrolled areas. The physiological effects of exposure to such levels as these are discussed in Appendix A. It was concluded that, based on the results of this investigation, Project Rulison had no lasting effect on the radiation environment in the vicinity of the test. This conclusion is based on the fact that none of more than seventy samples indicated any significant activity. The samples were all characterized by very low levels (actually not significantly different than background) and were comparable to the level measured in the Colorado River upstream from the area where the samples of this study were taken. It is highly unlikely that Colorado River water, upstream from the blast site and with its high year-round flow rate, would contain any radioactivity from the Rulison site two years after the shot and six months after cessation of test flaring. This investigation essentially corroborates the AEC sponsored monitoring which was done at the time of flaring, which indicated zero or negligible environmental radiation in the Rulison vicinity. (auth)

2615 (POR-6750) INTERMEDIATE-RANGE AIRBLAST. Project Officers Report. Project LN105 [of] Middle North Series, Mixed Company III Event. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1973. 63p. Dep. NTIS $5.25.

Airblast measurements were made between 9150 and 87,340 ft from the detonation of a one-million-pound TNT sphere resting on the ground surface. Peak overpressure, peak negative pressure, and positive and negative impulse attenuated with distance about as expected, except at the most distant station where all parameters, and especially peak overpressure, were less because the station was almost 2000 ft below the shot point. Blast-wave energy at two stations was considerably greater than normal attenuation or terrain effects would account for. Presumably additional energy scattered into the ground level from regions above the surface, indicating the effects of a non-homogeneous atmosphere. (auth)

2616 (SLA-73-741) BLAST PREDICTIONS AND MICROBAROGRAPH MEASUREMENTS, PROJECT LN-106; PROJECT MIXED COMPANY FINAL REPORT. Reed, J. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1973. 50p. (POR-6603). Dep. NTIS $4.50.

Blast predictions, based on a weather watch, were provided for three Project Mixed Company explosion tests of 20- and 500-ton chemical high explosives near Grand Junction, Colorado. The intent was to avoid firing in weather conditions which could duct or focus blast waves by atmospheric refraction and unnecessarily disturb the neighboring population. Recommendations were also made to help minimize close-in damage and prevent any hazard to both project and nonproject personnel and aircraft. In general, blast wave amplitudes recorded at nearby communities (10 to 30 km) were held well below standard explosion values by firing with only strong sound velocity/height gradients, which refracted the blast waves away from ground level. (auth)

2617 (UCRL-74710) UTILIZATION OF THE NOBLE GASES IN STUDIES OF UNDERGROUND NUCLEAR DETONATIONS. Smith, C. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Sep 1973. 12p. (CONF-730915-6). Dep. NTIS $3.00.

From symposium on noble gases; Las Vegas, Nevada, USA (24 Sep 1973).

The Livermore Gas Diagnostics Program employs a number of rare gas isotopes, both stable and radioactive, in its investigations of the phenomenology of underground nuclear detonations. Radioactive gases in a sample are radiochemically purified by elution chromatography, and the separated gases are radioassayed by gamma-ray spectrometry and by internal or thin-window beta proportional counting. Concentrations of the stable gases are determined by mass-spectrometry, following chemical removal of the reactive gases in the sample. The most general application of the noble gases is as device fraction indicators to provide a basis for estimating totals of chimney-gas components. All of the stable rare gases except argon have been used as tracers, as have ^{127}Xe and ^{85}Kr. ^{37}Ar and ^{85}Kr have proven to be of particular value in the absence of a good tracer material as reference species for studies of chimney-gas chemistry. The rate of mixing of chimney gases and the degree to which the sampled gas truly represents the underground gas mixture can be studied with the aid of the fission-product gases. ^{222}Ra and He are released to the cavity from the surrounding rock and are therefore useful in studies of the interaction of the detonation with the surrounding medium. (auth)

2618 OBSERVATIONS OF PKIKP AT DISTANCES LESS THAN 110°. Buchbinder, G. G. R.; Wright, C.; Poupinet, G. (Dept. of Energy, Mines, and Resources, Ottawa). Bull. Seismol. Soc. Amer.; 63: No. 5, 1699-1707(Oct 1973).

PKIKP phases have been identified at the Yellowknife Array from one nuclear explosion at a distance of 44°, and 18 earthquakes over the distance range 70° to 100°. In addition, PKIKP phases from two nuclear events were observed at 8 single seismometer stations at distances between 21° and 43°. The measured travel times and slownesses agree satisfactorily with those calculated using recent core models. The observed amplitudes are also close to the predicted values when compared with PKIKP amplitudes determined at LASA in Montana. Because of the large scatter of the observed PKIKP amplitudes and the complexities associated with the reflection of PcP, the amplitude ratio PKIKP/PcP does not readily yield detailed information on the inner core boundary. (auth)

2619 STATISTICAL CORRELATION OF OBSERVED GROUND MOTION WITH LOW-RISE BUILDING DAMAGE. Scholl, R. E.; Farhoomand, I. (John A. Blume and Associates, Las Vegas, NV). Bull. Seismol. Soc. Amer.; 63: No. 5, 1515-1537(Oct 1973).

A statistical study was conducted correlating ground motion with structure damage data from the RULISON underground nuclear explosion gas stimulation experiment. The statistical study first leads to the identification of the groundmotion characterization that best represents the damage potential of ground motion; then to the development of motion-damage relationships for low-rise buildings subjected to ground motion. The motion-damage relationships are derived both for overall damage as well as for the most frequently damaged building components. The overall motion-damage relationships are given in terms of incidence of complaints (complaint ratio), incidence of damage (damage ratio), and damage cost (damage cost factor). (auth)

2620 NUCLEAR STIMULATION OF NATURAL GAS. Hearing Before the Subcommittee on Public Lands of the Committee on Interior and Insular Affairs, United States Senate, Ninety-Third Congress, First Session on May 11, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 895p. GPO.

The May 11, 1973 hearing before the U. S. Senate Subcommittee on Public Lands on the use of public lands for the nuclear stimulation of natural gas are reported verbatim. Statements, communications, and appendixed information from public officials, industry representative, scientists, and environmentalists are included. (890 pp) (LCL)

Protective Structures and Equipment

Refer also to abstract 3184.

ENVIRONMENTAL AND EARTH SCIENCES

2621 POWER INDUSTRY AND THE ENVIRONMENT. Tallman, W. C. pp 1-5 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

The development of the Electric Power Council on Environment, the objectives of the Council, and the relationship between electric power and the environment are discussed briefly. (LCL)

2622 POWER ENVIRONMENT IN THE 1970'S. Goss, F. L. (Los Angeles Dept. of Water and Power). pp 7-19 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969.

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

The first two years of operation of the National Electric Reliability Council are reviewed by discussing what constitutes a reliable system, the adequacy of power supply in 1970, the accuracy of forecasting consumer demands, environmental problems, and the balance required in planning for increased power output while minimizing adverse environmental effects from such power production. (LCL)

Minerals and Ores

Refer also to abstract 2636.

2623 (INIS-mf-165/8) MINERALIZATION OF THE FRACTURE STRUCTURE OF THE SLAVKOVICE URANIUM DEPOSIT. Souba, M. (Geologicky Pruzkum Uranoveho Prumyslu, Nove Mesto na Morave (Czechoslovakia)). 1970. 26p. (In Czech). INIS.

A detailed description is presented of the mineralization in the Slavkovice uranium deposit. The mineral structure of veins, including the mutual relations of individual parageneses, successions, and certain genetic problems were studied. The development of mineralization can be divided into the following stages: the quartz development stage, the dolomite-quartz development stage, and the carbonate-uraninite-selenide-sulphide-chloritic development stage. (INIS)

2624 POTASSIUM, THORIUM, AND URANIUM CONTENTS OF UPPER CENOZOIC BASALTS OF THE SOUTHERN ROCKY MOUNTAIN REGION, AND THEIR RELATION TO THE RIO GRANDE DEPRESSION. Lipman, P. W.; Bunker, C. M.; Bush, C. A. J. Res. U. S. Geol. Surv.; 1: No. 4, 387-401(1973).

Late Cenozoic basaltic volcanism in southern Colorado and northern New Mexico was most intense near the Rio Grande rift depression but extended onto stable platforms to the west (Colorado Plateau) and to the east (High Plains). Tholeiitic rocks are largely confined to the Rio Grande depression, and the basalts become increasingly alkalic with distance from the depression. The K, Th, and U contents and the Th/K and U/K ratios consistently increase away from the depression, and Th/U ratios also tend to increase slightly. Geographically distinct suites of petrographically related basalts that are very similar in major-oxide compositions are readily distinguishable by K, Th, and U contents. Sialic crustal contamination did not contribute significantly to development of these compositional variations, and the lateral change from tholeiitic to alkalic basaltic volcanism may be related to different depths of or degrees of partial melting in the mantle. The compositions and compositional ranges of basalts in the southern Rocky Mountain region are similar to those of many Pacific islands, despite the contrasting geologic settings. (auth)

2625 RADIOELEMENT AND RADIOGENIC HEAT DISTRIBUTION IN DRILL HOLE UCe-1, BELMONT STOCK, CENTRAL NEVADA. Bunker, C. M.; Bush, C. A. J. Res. U. S. Geol. Surv.; 1: No. 3, 289-292(1973).

Uranium, thorium, and potassium concentrations were measured in 60 samples collected from an exploratory hole drilled in the Belmont stock about 40 miles north-northeast of Tonopah, Nev. The results indicate that, at least within 2,000 feet of the surface, the granitic pluton contains radioelement concentrations similar to those in average granodiorites and that local variations in concentrations may reflect the effects of argillic alteration. (auth)

2626 RARE ELEMENTS OCCURRING IN MICA. Kapustin, Yu. L.; Kapitonova, T. A. (Inst. of Mineralogy and Geochemistry of the Rare Elements, Moscow). Zap. Vses. Mineral. Obshchest.; 101: No. 6, 346-360(Nov 1972). (In Russian).

Micas of different genetic formations concentrate Li, Rb, Cs, Be, Ba, Tl, Nb, Ta, Zr, REs, U, and Th. In order to determine the form of these elements in mica, studies were made on muskovite, biotite, floganite, and lepidolite from granites, pegmatites metasomatites, alkali rocks, and carbonates of the Ukraine, Karelia, the Kolski Peninsula, Urals, and Siberia. Microinclusions of rock-forming and accessory minerals of Ti, Nb, Ta, Zr, rare earths, U, and Th were found, the same as in the containing micas of rocks. The predominance of the same group of rare elements in micas as in the enclosing rocks and their minerals was established. The closeness of the Nb/Ta, Zr/Hf, and U/Th ratios and of the rare earths in micas and the associated basic mineral carriers of these elements was demonstrated. The differential nature of the occurrence of rare elements found in micas was assumed; Li, Rb, Cs, Sr, and Ba and partially Be and Ti enter into the structure of micas; isomorphically substituted K, Mg, Al, Si, U, Th, rare earths, Zr, Ta, and Nb and partially Ti are present in micas, principally as microinclusions of the typical minerals of these elements. The total composition of micas reflects the geochemical specificity of the rocks enclosing them, but the form of the occurrence of the individual rare elements should be studied by special methods. (trans-auth)

2627 AVERAGE URANIUM CONTENTS IN PRECAMBRIAN FORMATIONS OF THE UKRAINIAN SHIELD. Zhukova, A. M. (Inst. of Geochemistry and Physics of Minerals, Kiev). Geokhimiya; No. 8, 1245-1253(Aug 1973). (In Russian).

The uranium contents of the different parts of the Ukrainian Shield are tabulated, and the various formations are described in tabular form. The uranium content is low in 40 to 45% of the Shield; in 12% of the area, the content is about the same as in the general earth's crust; and in about half the shield the content is 1.5 to 4 times that in the general crust with the 4-fold value in 2 to 3% of the total Shield. (MG)

Radioactive Effluents

Refer also to abstracts 2647, 2909, 3146, and 4593.

2628 (DPSPU-72-30-10) ENVIRONMENTAL EFFECTS OF A COMPLEX NUCLEAR FACILITY. Bebbington, W. P. (DuPont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Plant). Jun 1973. Contract AT(07-2)-1. 14p. (CONF-731109-1). Dep. NTIS $3.00.

From AIChe sixty-sixth meeting; Philadelphia, Pennsylvania, USA (11 Nov 1973).

Fuel fabrication, nuclear reactors, and chemical reprocessing have all been in operation for nearly 20 years at the U. S. Atomic Energy Commission's Savannah River Plant. The Plant's experience and the present condition of its 300-square-mile site provide bases for judging the effects of complex nuclear operations on the environment. It is concluded that nuclear technology can be and has been controlled to provide useful services without harmful consequences. (auth)

2629 (LA-UR-73-1309) DISTRIBUTION OF PLUTONIUM IN LIQUID WASTE DISPOSAL AREAS AT LOS ALAMOS. Hakonson, T. E.; Johnson, L. J.; Purtymun, W. D. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. 6p. (CONF-730907-13). Dep. NTIS $3.00.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

An ecological investigation is described of plutonium in the Los Alamos Scientific Laboratory environs. Data are presented on the distribution of plutonium in the alluvial sediments, water, vegetation, and rodents from Mortandad Canyon, an area which has been used for liquid waste disposal for 10 years. (auth)

2630 IDENTIFICATION AND MEASUREMENT OF ENVIRONMENTAL POLLUTANTS. Proceedings of a Symposium Held in Ottawa, Ontario, Canada, June 14, 15, 16, 17, 1971. Westley, B. (ed.). Ottawa; National Research Council of Canada (1971). 458p. (CONF-710668-).

Separate abstracts were prepared for 8 of the 81 papers presented in these proceedings. The other 73 papers discuss general and specific methods for the identification and measurement of pollutants in all aspects of the environment. (ERB)

For abstracts of individual papers see: 2425, 2426, 2443, 2444, 2631, 2638, 2670, and 2671.

2631 MONITORING OF RADIOACTIVE ISOTOPES IN ENVIRONMENTAL MATERIALS. Grummitt, W. E. (Chalk River Nuclear Labs., Ont.). pp 399–403 of Identification and Measurement of Environmental Pollutants. Westley, B. (ed.). Ottawa; National Research Council of Canada (1971).

From international symposium on identification and measurement of environmental pollutants; Ottawa, Canada (14 Jun 1971). See CONF-710668–.

The monitoring of gamma emitting nuclides in the environment is feasible with a lithium drifted germanium detector, possessing high resolution, coupled to a stable multi-channel analyzer. Large samples of air, water, or biota are reduced in volume and counted for periods of minutes to several hours. The sensitivity of the method for water is 0.02 pCi/liter for nuclides such as cesium-137 and cobalt-60. The method has several advantages over the conventional one of chemical separation and β counting. Positive identification is achieved through the characteristic gamma ray energy. All nuclides are determined simultaneously and several isotopes of the same element can be estimated quantitatively from a single scan. No chemical manipulation is required. The system has an extremely low background counting rate—two counts per hour in the photopeak channels corresponding to cobalt-60. Although the overall efficiency is a factor of five to ten times lower than for β counting, sample size can normally be increased to compensate for the lower counting efficiency. (auth)

Radioactivity Monitoring and Transport

2632 (KFK-EXT-23/73-1) RESULTS OF MONITORING FOR TRITIUM INCORPORATION AT THE KARLSRUHE NUCLEAR RESEARCH CENTER IN 1971. Schieferdecker, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Medizinische Abt.). Apr 1973. 12p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

The results of the monitoring activities for tritium at the Karlsruhe Nuclear Research Center in 1971 showed that there were no increases in incorporation by personnel relative to previous years, despite the increasing work load. In no case was the maximum permissible dose exceeded. The maximum dose due to tritium incorporation was between 50 and mrem/a. (GE)

2633 β-RADIOACTIVITY OF FUNGI IN POLAND. Kwapulinski, J. Acta Geophys. Pol.; 20: 217–222(1972). (In Polish).

The radioactivity of fungi growing in 50 to 54°N latitude was measured by means of an anticoincidence method with a background of 2 imp/min. Fungi from the southern (mountainous) regions were more radioactive (annual mean 76.8 pCi/g) than those from the northern (maritime) regions (annual mean 36.1 pCi/g). The annual average mean radioactivity of fungi was 55.7 pCi/g for total fallout 74.6 mCi/km^2 per month. The average cumulation coefficient for fungus-soil system is 16 with variations in range 3 ÷ 82. (Nucl. Sci. Abstr. Pol.)

Atmosphere

Refer also to abstract 2459.

2634 (BNL-18301) ATMOSPHERIC DIFFUSION FROM AN OFF-SHORE SITE. Michael, P.; Raynor, G. S.; Brown, R. M. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 10p. (CONF-731110-5). Dep. NTIS $3.00.

From symposium on the physical behavior of radioactive containment in the atmosphere; Vienna, Austria (12 Nov 1973).

Analysis of the fate of airborne effluents from a nuclear reactor at an off-shore site requires a better understanding of overwater atmospheric dispersion than currently exists. For this reason, a diffusion study was undertaken off the south shore of Long Island, New York, about 100 km from New York City. This study is using tracer material (oil fog smoke) released from an anchored boat. Measurements of mean wind, turbulence, and temperature are made on portable towers on the beach, from an aircraft, and aboard the source boat. Plume geometry is documented by photography and from quantitative concentration measurements. Experiments under a variety of meteorological conditions indicate that over-water dispersion is very sensitive to meteorological conditions. From measured diffusion parameters it was observed that over-water dispersion is significantly less than over land, particularly when the onshore flow is due to the sea breeze. This is because of the low aerodynamic roughness of the water, and because low level stable conditions are established because the water is at lower temperature than the air. Crosswind standard deviations of the plume a factor two less than the prediction of Pasquill category F have been observed at the shore with the source 6 km off shore. (auth)

2635 (INP-841) PRELIMINARY INVESTIGATIONS OF THE IONIZATION AND RADIOACTIVE CONTAMINATION OF THE AIR IN THE WIELICZKA SALT MINE. Jura, Z.; Niziol, B.; Zakrocki, Z. (Institute of Nuclear Physics, Krakow (Poland)). 1973. 33p. (In Polish). Dep. NTIS (U. S. Sales Only) $3.75.

Measurements of light ion concentrations, air radioactivity, dust concentration, air humidity, and temperature in the Wieliczka salt mine in Poland were carried out to detect factors that may be decisive in the therapeutic properties of the air in this mine. It was found that ion concentrations depended on the passage of air inside the mine. The total radioactivity of the air at the "Kościuszko" shaft bottom equals about 1.4 × 10^4 pC per cubic meter. Spectrum analysis of the γ radiation showed in the air the presence of radioactive elements belonging to the Uranium-Radium and Thorium radioactive series. Dust concentration for dust granules of diameter greater than 0.8 um was between 60 and 560 granules per ccm. The relative humidity of the air inside the mine varied from 60 to 67% and the temperature from 17.4°C to 18°C. (auth)

2636 URANIUM MINE VENTILATION PLANNING FOR CONTROL OF RADON AND ITS DAUGHTERS. Puri, R. C. (Dept. of Atomic Energy, Naurapahar, India). J. Mines, Metals Fuels; 21: No. 2, 34–40(Feb 1973).

The additional function of ventilation to keep the concentration of radon gas (Rn^{222}, a product of nuclear decay of uranium) and its radioactive decay products below the permissible limits, to guard uranium miners' lungs against harmful radiation exposures in a radioactive uranium ore metalliferous mine is discussed. Control over contaminant influx will determine the dilution ventilation required. The need for a well-organized ventilation system to satisfactorily dilute and remove the contamination that unavoidably results during mining is stressed. (INIS)

2637 IONIZIRUYUSHCHIE IZLUCHENIYA BIOSFERY. (Ionizing Radiation in the Biosphere). Pertsov, L. A. Moscow; Atomizdat (1973). 288p.

This monograph is in two parts. The first part presents material reflecting the principles of formation of natural radiation burdens of plants, animals, and humans. The sources causing variation in these burdens are discussed and the effect of modern technological progress on the shift in the constituent radiation fields is considered. Concepts of radiation background are interpreted and background classifications are given. Data are presented on the reactivity of the components of the medium surrounding tissues of plants, animals, and man. Both original and literature data are used in the presentations. The second part presents an analytical review of potential sources of radiation contamination of the biosphere. The danger of probable uncontrolled admission of radionuclides to the external medium is evaluated. The mechanism of their distribution in air, rivers, soil, and in biological cycles is considered. (tr-auth)

2638 PROGRESS IN STANDARDIZATION OF METHODS FOR AMBIENT AIR SAMPLING AND ANALYSIS. Hendrickson, E. R. (Environmental Engineering, Inc., Gainesville, FL); Stern, A. C. pp 59–61 of Identification and Measurement of Environmental Pollutants. Westley, B. (ed.). Ottawa; National Research Council of Canada (1971).

From international symposium on identification and measurement of environmental pollutants; Ottawa, Canada (14 Jun 1971). See CONF-710668–.

In the United States, seven professional societies have undertaken a cooperative project to develop acceptable methods for the sampling and analysis of air pollutants. The effort is supported in part by the Air Pollution Control Office, E.P.A. An Intersociety Committee, consisting of representatives from each of the cooperating societies, is guiding the project and serving as an editorial board. An editor, with the assistance of expert "substance sub-committees," is selecting the most appropriate methods and writing up the procedures in a uniform format. After acceptance by the Intersociety Committee, the method may be designated as a Tentative Method. Each method will then be subjected to a collaborative testing program before it can be designated as a Standard Method. At this time, 45 tentative methods have been published, three are in the process of collaborative testing, and a total of 95 are in some stage of development. (auth)

Soil

2639 (INIS-mf-165/1) MATHEMATICAL MODELLING OF NATURAL RADIOACTIVITY ANOMALIES. Krestan, J. (Geologicky Pruzkum Uranoveho Prumyslu, Hamr na Jezere (Czechoslovakia)). 1970. 42p. (In Czech).

A new method is described of automatic interpretation of measurements of natural radioactivity in boreholes. The method assumes that the environment of the borehole can be represented by a set of parallel radioactive strata of small constant thickness with a homogeneous dispersion of radioactive substances. The measured activity curve results from a summation of the effects of these elementary strata; a quantitative interpretation by computers is thus made possible. (INIS)

2640 (INIS-mf-165/2) EFFICIENCY OF EMANATION AND GAMMA SURVEY TECHNIQUES EMPLOYED IN TWO METERS DEEP TEST-PITS IN THE NORTHEASTERN PART OF THE MORAVIAN BRANCH OF THE MOLDANUBICUM. Duda, V.; Vesely, V. (Geologicky Pruzkum Uranoveho Prumyslu, Hamr na Jezere (Czechoslovakia)). 1970. 25p. (In Czech). INIS.

The effectiveness of emanation and gamma survey in test-pits 2 meters deep was experimentally determined and compared with emanation measurements in depths not exceeding 1 meter. The investigation was carried out in the north-eastern part of the Moravian branch of the Moldanubicum. The procedures of emanation and gamma survey are evaluated and an analysis is made of the shape and size of gamma radiation fields of radioactivity anomalies. (INIS)

Water

Refer also to abstracts 2451 and 2614.

2641 (TID-26445) DISCHARGE AND FLOW DISTRIBUTION, COLUMBIA RIVER ESTUARY. Open-file Report. Lutz, G. A.; Hubbell, D. W.; Stevens, H. H. Jr. (Geological Survey, Bay St. Louis, Miss. (USA)). 1973. 80p. Dep. NTIS $5.45.

Low-level radioactive wastes were discharged into the Columbia River at the Hanford Reservation, U. S. Atomic Energy Commission, near Richland, Wash. from 1944 until early 1971. In the river, the various radionuclides that made up the waste associated with sediment and biota or remained in solution and subsequently were distributed throughout the estuary and into the Pacific Ocean. To provide information on the amount of radionuclides being transported through the estuary, continuous records of water discharge were obtained near both the upper and lower ends of the estuary during 1968 to 70. Complex velocity distributions, mainly due to salinity gradients, made it impossible to use conventional methods of measuring discharge in the lower part of the estuary. A new technique, MOVD (measurement of velocity distribution by moving boat), was developed for determining the magnitude and direction of the water velocity throughout the entire depth at a vertical. Repetitive measurements at a series of verticals in cross sections at the Beaver Army Terminal, Oreg., Columbia River mile 53.3, and at Astoria, Oreg., Columbia River mile 14, defined flow hydrographs at these locations during half tidal cycles on a number of occasions. The defined flow hydrographs were used to calibrate mathematical models for computing continuous records of discharge and rates of transport of radionuclides at cross sections along the longitudinal axis of the estuary. (CH)

Ecosystems and Food Cycles

Refer also to abstract 2956.

2642 (EUR-4966) BIOSYSTEMS MODELING: A PRELIMINARY BIBLIOGRAPHIC SURVEY. Argentesi, F.; Di Cola, G.; Verheyden, N. (Commission of the European Communities, Brussels (Belgium)). Oct 1973. 44p. Dep. NTIS (U. S. Sales Only) $4.25. EUR B.Fr. 60,-.

Some 300 references are presented to literature published through December 1972 on mathematical models of energy flow in ecosystems and the transport of radionuclides and chemical contaminants through food chains to man. References are included to related studies on biosystems modeling. (CH)

Radiometric Techniques

Refer also to abstracts 2649 and 2789.

2643 GEOFIZICHESKIE METODY ISSLEDOVANIYA SKVAZHIN. (Geophysical Methods for Investigating Boreholes). Komarov, S. G. Moscow; Izdatel'stvo Nedra (1973). 368p.

The equipment and arrangement required to make electrical resistivity measurements on various strata during drilling operations are described. Surveying with single, three- and seven-electrode units is described. Considerable background material on resistivity measurements is presented. Induction methods are also described. The radiometric methods include gamma surveying, where the natural radioactive content of strata materials (uranium and thorium generally) is measured by gamma counting. Clay minerals show a high count, while sand and dolomite minerals give low gamma counts. In gamma-gamma methods of surveying boreholes the amount of soft scattered gamma radiation depends mainly on the density of the stratum, and is inversely proportional to the heavy metal content. This method is most useful in determining the density of a stratum. Neutron survey methods are useful in detecting high hydrogen content of a stratum (one containing gas or oil) or in determining the composition of a stratum from the induced activity. The characteristics of these detectors are described in detail. The characteristics of acoustic and magnetic survey methods are described. Methods of analyzing the drilling mud for hydrocarbon gases are presented. Temperature measurements in the borehole, and methods of measuring the curvature of the borehole are presented. The use of computers in interpreting and using survey data is discussed. (SJR)

Site Surveys

Refer also to abstracts 2612, 2625, 4609, and 4654.

2644 (ARMS-70.6.10) RADIOLOGICAL SURVEY OF THE AREA SURROUNDING THE ROBERT EMMETT GINNA NUCLEAR POWER PLANT, ONTARIO, NEW YORK. Date of Survey: 8 September 1970. Technical Report No. L-1096. (EG and G, Inc., Las Vegas, Nev. (USA)). 6 Apr 1973. Contract AT(29-1)-1183. 12p. (EGG-1183-1582). Dep. NTIS $4.00.

The Aerial Radiological Measuring System (ARMS) was used to survey the area surrounding the Robert Emmett Ginna Nuclear Power Plant during September 1970. The survey measured terrestrial gamma radiation. A high-sensitivity detection system collected gamma ray spectral and gross count data. The data were then computer processed into a map of a 325 square mile area showing isoexposure contours three feet above the ground. Exposure rates and isotopes identified are consistent with normal background radiation. (auth)

2645 (MLM-2094(OP)) MOUND LABORATORY ENVIRONMENTAL CONTROL PROGRAM. Hebb, J. L. (Mound Lab., Miamisburg, Ohio (USA)). [nd]. Contract AT(33-1)-Gen-53. 7p. (CONF-731110-4; SM-181/21). Dep. NTIS $3.00.

From symposium on the physical behavior of radioactive containment in the atmosphere; Vienna, Austria (12 Nov 1973).

The radiation monitoring program at Mound Laboratory is reviewed briefly. The in-plant monitoring system detects and measures continuously all waste discharges, and this is supplemented by weekly detailed laboratory analysis of samples to ensure compliance with air quality and water quality codes. The air monitoring program for radioactivity covers an area of approximately 380 square miles in the environs of the plant. (CH)

2646 (NERC-LV-539-24) OBSERVATIONS ON WILDLIFE AND DOMESTIC ANIMALS EXPOSED TO THE GROUND MOTION EFFECTS OF UNDERGROUND NUCLEAR DETONATIONS. Smith, D. D. (National Environmental Research Center, Las Vegas, Nev. (USA)). Oct 1973. Contract AT(26-1)-539. 19p. Dep. NTIS $4.00.

Domestic animals and wildlife were frequently observed or intentionally stationed in close proximity to surface ground zero at the time of underground nuclear detonations at the Nevada Test Site and at other test locations within the contiguous United States. Subjective summaries are given of large animal involvement with specific nuclear events. It is noted that physical damage from ground motion has not been reported. Recommendations are made for experimental verification of these subjective observations. (auth)

2647 (PEL-226) MOVEMENT OF SOME NUCLEAR FISSION AND ACTIVATION PRODUCTS IN DUINEFONTEIN SOIL. van der Westhuizen, H. J.; van Rensburg, H. A. J. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Feb 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

As part of the site investigation in connection with the erection of the first South African nuclear power station, Koeberg-A (Escom Reactor), the movement in the ground of important products of nuclear fission and activation was investigated. The sorbtion capacity of different layers of the ground for the elements was determined by laboratory tests. The tests were conducted using a solution that corresponds to the groundwater of the reactor site. Results of these tests were used to calculate the relative speed of the ion front of each element in relation to the liquid front. The values obtained indicate that the speeds at which the various elements move through the ground under the influence of the moving groundwater are spread out over a wide range. The movement of Ru, Ce, Co, Mn, and Zn was retarded by sorption on sand and in view of the relatively short half-lives of their radionuclides, it was concluded that they would not constitute a serious hazard. Both ^{137}Cs and ^{90}Sr moved too rapidly through the sand to allow sufficient time for their decay and it was concluded they would be a hazard to the biosphere. (CH)

2648 EARTH-SCIENCE STUDIES OF A NUCLEAR TEST AREA IN THE WESTERN ALEUTIAN ISLANDS, ALASKA: AN INTERIM SUMMARY OF RESULTS. Carr, W.; Gard, L. M.; Bath, G. D.; Healey, D. L. (Geological Survey, Denver). Geol. Soc. Amer., Bull.; 82: 699-706(Mar 1971).

Recent multi-disciplinary studies by the U. S. Geological Survey conducted on and near Amchitka Island in the Aleutians have contributed much to a better understanding of the geologic, hydrologic, and tectonic environment of the island as an underground nuclear test site. The work included geologic mapping, isotopic dating, deep drilling, geophysical surveys, hydrologic investigations, and post-test effects examinations. Three distinct volcanic episodes have been distinguished and dated. A general volcanotectonic history of the arc is proposed. The islands in the vicinity of Amchitka have apparently been stable tectonically in the late Pleistocene and Holocene. Most of the gravity and magnetic data can be interpreted in terms of known structure and rock distribution. Marine geophysical data tend to confirm structural stability of the insular area and indicate a scarcity of sedimentary material in the insular slopes and shelf. Geologic effects of underground tests have been minor. (auth)

2649 US GEOLOGICAL SURVEY, DENVER, COLORADO, RADIOCARBON DATES. I. Schroder, L. J.; Beetem, W. A.; Claasen, H. C.; Emerson, R. L. (Geological Survey, Lakewood, CO). Radiocarbon; 15: No. 3, 469-478(1973).

Hydrologic studies were made by the U. S. Geological Survey in support of the nuclear testing program of the U. S. AEC Radiocarbon dates from samples of water obtained during these hydrologic studies are used to aid in hydrologic interpretations of the study areas. Data describing the wells and springs sampled were taken from records of the Nevada State Engineer and then field checked. Water samples were collected in a manner to minimize contamination by atmospheric CO_2. Through the addition of barium chloride and a precipitation procedure, sufficient barium carbonate is obtained to yield at least 3g carbon after synthesization. The source data for 48 samples analyzed, the ^{14}C dates calculated, and tabulated data on the ^{14}C, δ^{13}C content, and total alkalinity of each sample are presented. (LCL)

Thermal Effluents

Refer also to abstracts 2628, 2630, and 4521.

2650 (KFK-1654-UF) THEORETICAL MODELS FOR THE SELF-PURIFICATION OF RIVERS. Stehfest, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Aug 1973. 102p. (In German). Dep. NTIS (U. S. Sales Only) $7.25.

The self-purification process in rivers is described qualitatively. Different ways of representing this process by systems of differential equations are discussed. The parameters of the differential equations cannot be measured directly, but must be estimated from experimental values of the dependent variables. For this problem, called model identification, the quasilinearization technique is recommended and explained. The technique is applied to self-purification models of some simple laboratory studies. A model is given of rivers whose benthos may be neglected. Its dependent variables are: concentration of easily degradable wastes, concentration of slowly degradable wastes, bacterial mass concentration, protozoan mass concentration, and oxygen concentration. Keeping the measurements within reasonable limits, the conditions under which this model can be identified are investigated. Finally, a self-purification model of the Rhine river between Mannheim/Ludwigshafen and the Dutch–German border is proposed. It is shown that the model is consistent with the measured data. The model is used to estimate the consequences of activities such as waste heat disposal or sewage treatment. (GE)

2651 CONCEPTUAL DESIGN OF A FOOD COMPLEX USING WASTE WARM WATER FOR HEATING. Beall, S. E. (Oak Ridge National Lab., TN). J. Environ. Qual.; 2: No. 2, 207-215(1973).

The US Atomic Energy Commission has supported a small program at the Oak Ridge National Laboratory (ORNL) to determine how the heat in waste warm water from electric generating plant condensers can be transferred economically to controlled environments, such as in greenhouses or animal enclosures; and to suggest, in a conceptual effort, how the heat exchange system could be applied to an intensive food production complex which might be constructed near a power station. A heat-using complex consisting of enclosures for fish, poultry, swine, and vegetable plants has been conceived with the goal of maximizing the use of heat and the wastes from the various operations by recycling. It is hoped that the concept will prove to be sufficiently attractive that a utility or an agribusiness company will undertake a small demonstration based on some of these ideas. (auth)

2652 ENVIRONMENTAL CONTROL IN ANIMAL SHELTERS USING POWER PLANT THERMAL EFFLUENTS. Hirst, E. (Oak Ridge National Lab., TN). J. Environ. Qual.; 2: No. 2, 116-171(1973).

Waste heat could be used by farmers to provide environmental control for broilers and swine. The amount of waste heat which could be so used is about 1 to 2% of the total available from electric power plants. A proposed system for using waste heat involves conventional pad and fan systems with finned-tube coils mounted downstream of the pads. The potential savings to farmers in fuel and feed costs are significant. However, major problems exist, that must be investigated to determine whether incentives exist to develop and implement such systems. These problems include economics, management, marketing, disposal of animal wastes, dispersion of farming units, size of agricultural operation, climate, and seasonality of waste heat demands. (auth)

2653 ELECTRIC POWER AND THERMAL DISCHARGES. Thermal Considerations in the Production of Electric Power. Conference held at Washington, DC, Jun 28–30, 1970. Eisenbud, M.; Gleason, G. (eds.). New York; Gordon and Breach, Science Publishers, Inc. (1969). 453p. (CONF-700680-).

Eighteen papers were presented. A separate abstract was prepared for each paper. (LCL)

For abstracts of individual papers see: 2621, 2622, and 2654–2669.

2654 ELECTRIC POWER AND THERMAL OUTPUT IN THE NEXT TWO DECADES. Warren, F. H. (Federal Power Commission, Washington, DC). pp 21-46 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

Demands for thermally generated electric power through 1990, the environmental impact of heated effluents released from these power plants via cooling ponds or evaporative cooling towers, and recommendations for coping with the thermal effects problems are discussed. (LCL)

2655 SPECTRUM OF BIOLOGICAL CONCERNS FROM POWER PLANT THERMAL DISCHARGES. Jensen, L. D. (Johns Hopkins Univ., Baltimore). pp 47-73 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

Thermal effects of power generation on aquatic organisms are discussed by considering: the state of the art of thermal biology; the levels at which the influence of temperature can be measured in the animal, either in the cell, tissue, organ, population, or species; classification of the effects as physiological, behavioral, and genetic; and the magnitude of effect including the adaptability of organisms to thermal change. In addition to the thermal effects of power generating stations, aquatic organisms must be protected from entrapment and entrainment in intake structures of cooling systems and from biocides used in the cooling water intake system to control fouling organisms. It is concluded that biologists will have an important role in the development of water quality criteria to minimize the environmental effects of power generation while maximizing the benefits of economical power generation. (LCL)

2656 IMPACTS OF THERMAL ALTERATIONS ON ESTUARINE AND COASTAL ENVIRONMENTS. Hargis, W. J. Jr.; Warinner, J. E. III. (Virginia Inst. of Marine Science, Gloucester Point). pp 75-141 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

The possible impacts of thermal effluents from fossil- and nuclear-fueled electric power generating plants on estuarine and coast waters and ecosystems are examined by considering: the geological, thermal, hydraulic, chemical, and biological characteristics of estuaries; both the direct and indirect biological effects of heating and heated waters; thermal tolerances in marine organisms; thermal effects on marine organism reproduction, mortality, and susceptibility to disease; how these effects must be included in power plant siting and design studies; and the development of water quality criteria for temperature. (LCL)

2657 BENEFICIAL USES OF WARM WATER DISCHARGES IN SURFACE WATERS. Strawn, K. (Texas A and M Univ., College Station). pp 143-156 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

Warm discharges from power plants into surface waters can have the beneficial effects of increasing the population and individual growth rate of fish, of protecting fish against unusually cold water as the result of severe weather conditions, of warming chilled waters for more comfortable swimming conditions, and of making available warmed waters for controlled fish farming. Examples are given of these benefits as experienced near specified power stations. (LCL)

2658 WATER QUALITY STANDARDS: ENFORCEMENT AND COMPLIANCE. Stein, M. (Federal Water Quality Administration, Washington, DC). pp 157-181 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

The Federal Water Quality Administration was established to enhance the quality and value of US water resources by establishing a national policy for the prevention, control, and abatement of water pollution. The enactment of the National Environmental Policy Act in 1970 gave further impetus to achieving this goal. The activities of the Federal Water Quality Administration as related to the electric power industry, particularly in the field of setting and enforcing water quality standards, are discussed. (LCL)

2659 PRACTICAL IMPLICATIONS OF APPLYING CRITERIA IN A VARIETY OF CONDITIONS. Johnson, R. E. (Dept. of the Interior, Washington, DC). pp 183-187 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

The need for establishing meaningful standards for the maximum permissible thermal pollution of waters, especially as caused by power plant discharges, is discussed. (LCL)

2660 THERMAL WASTE TREATMENT AND CONTROL. Rainwater, F. H. (Pacific Northwest Water Lab., Corvallis, OR). pp 189-212 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

The status of available technology for the prevention and control of thermal pollution and major advances in this technology expected in the near future are discussed. (LCL)

2661 DEVELOPING AND APPLYING STANDARDS AT THE STATE LEVEL. Boardman, R. M. pp 213-227 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

The experience in the State of Pennsylvania in developing and enforcing water quality standards related to thermal pollution is described. These regulations were adopted in 1961 and have been ammended periodically to meet more recently established national standards. (LCL)

2662 CONSIDERATIONS IN TRANSLATING ENVIRONMENTAL CONCERN INTO POWER PLANT DESIGN AND OPERATION. Lee, W. S. (Duke Power Co., Charlotte, NC). pp 229-248 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

In designing a cooling water system to dissipate waste heat from a power plant, designers must consider the environmental effects related to land use, air and water quality, local meteorology, and local vegetation, land animals and wildlife, and aquatic organisms. The tools needed to make decisions related to these multiple considerations are described by summarizing what is known and can be applied now and what must be known in the future so that environmental concerns will be included in power plant design. (LCL)

2663 POWER PLANT COOLING IN PERSPECTIVE. Kelsall, A. C. (Commonwealth Associates, Inc., Jackson, MI). pp 249-268 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.) (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

The advantages of central power plants as the most efficient power producers, the need for greater understanding by the general public of measures taken by utility companies to protect and enhance the environment, and the relative merits of cooling towers and cooling ponds as a means of dissipating heat released from power plants are discussed. (LCL)

2664 SHORT TERM PROSPECTS FOR IMPROVING EFFICIENCY OF POWER PLANTS. Woodson, H. H. (Massachusetts Inst. of Tech., Cambridge). pp 269-279 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

Continuing to improve the efficiency of power plants would reduce the cost of electrical energy, decrease the quantity of waste heat released to the environment, and conserve fuel resources. The possibilities for efficiency improvements in both fossil-fuel and nuclear power plants during the next 10 to 15 years are discussed. (LCL)

2665 ENVIRONMENTAL INFLUENCE ON POWER SYSTEM OPERATION. Tillinghast, J. pp 281-294 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

Any form of electric power generation will have an impact on the environment. The challenge is to produce electricity to meet growing power demands while minimizing the environmental effects. The influence of concern for the environment and of current and proposed pollution, particularly thermal pollution, regulations on power system operations from fuel supply to generation to transmission and distribution are discussed. (LCL)

2666 NATURAL BODIES OF WATER FOR COOLING. Kolflat, T. D. (Sargent and Lundy, Chicago). pp 295-349 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

The natural behavior of all natural bodies of surface water and the influences of non-natural heat additions on this natural behavior are discussed in terms of the physical characteristics of water, including density, viscosity, water vapor pressure, and gas solubility, and in terms of the physical characteristics of bodies of water, i.e., circulation, thermal gradients, flow rate, evaporation, heat transfer capacity, etc. Examples are given of the use of manmade lakes for cooling heat discharged from power plants. (LCL)

2667 COOLING TOWERS FOR LARGE STEAM-ELECTRIC GENERATING UNITS. Woodson, R. D. (Massachusetts Inst. of Tech., Cambridge). pp 351-380 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

An analysis is presented to provide a realistic outlook on the use of cooling towers for removal of the heat rejected in the exhaust steam from the main and auxiliary condensing turbines of large steam-electric generating units. All feasible types of cooling towers are considered and the comparative economy of each type is illustrated for a typical unit of 800 MW net generating capacity. (auth)

2668 USE OF RIVER MODELS IN POWER PLANT HEAT EFFECT STUDIES. Neale, L. C. (Worcester Polytechnic Inst., MA). pp 381-416 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

The construction, operation, instrumentation, and performance of river models used to simulate river flow conditions and to study the influence of heated water effluents, i.e., power plant cooling water discharges, on bodies of water are described in detail. The flow patterns developed from these model studies were used to predict the flow and temperature patterns in the prototype. Although detailed data from the field after completion of projects is difficult to obtain, the results that have been obtained indicate good agreement with those of the model study. (LCL)

2669 UTILIZING WASTE HEAT FOR URBAN SYSTEMS. Nutant, J. A. pp 417-423 of Electric Power and Thermal Discharges. Eisenbud, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1969).

From symposium on thermal considerations in the production of electric power; Washington, District of Columbia, USA (28 Jun 1970). See CONF-700680-.

Consolidated Edison of New York and Westinghouse Corp. have announced the initiation of a joint study on waste heat utilization in urban systems. The feasibility of using power plant waste heat for specific urban applications will be determined in order to choose one application for a demonstration project. Urban applications under consideration include: heating and air conditioning of residences and working spaces; surface water aeration to improve water quality; heating of sewage to affect more rapid and efficient sewage treatment; de-icing and de-fogging of airports; and greenhouse heating. (LCL)

2670 EFFECTS OF THERMAL DISCHARGES ON THE CHEMICAL PARAMETERS OF WATER QUALITY AND EUTROPHICATION. Lee, G. F.; Veith, G. D. (Univ. of Wisconsin, Madison). pp 287-294 of Identification and Measurement of Environmental Pollutants. Westley, B. (ed.). Ottawa; National Research Council of Canada (1971).

From international symposium on identification and measurement of environmental pollutants; Ottawa, Canada (14 Jun 1971). See CONF-710668-.

The temperature dependencies of the major chemical reactions, which are directly involved in the quality of natural waters, are reviewed. The effects of temperature variations on both the position of equilibria and the rates at which equilibria are attained are considered for acid-base, precipitation, gas transfer, complexation, oxidation-reduction, sorption, and biochemical reactions. Because of the small enthalpies and activation energies of many of the chemical processes, temperature variations induced by meteorological conditions and properly designed thermal discharges have only slight effects on chemical equilibria and reaction rates and little or no effect on the chemical parameters of water quality. A review of the current knowledge of eutrophication indicates that, while temperature increases may increase the growth rates of algae, the nutrient flux rather than the temperature controls the biomass of algae during the summer recreational period and the rate of eutrophication of lakes. (auth)

2671 RESPONSES OF THE BIOTA OF LAKE WABAMUN, ALBERTA, TO THERMAL EFFLUENT. Nursall, J. R.; Gallup, D. N. (Univ. of Alberta, Edmonton). pp 295-304 of Identification and Measurement of Environmental Pollutants. Westley, B. (ed.). Ottawa; National Research Council of Canada (1971).

From international symposium on identification and measurement of environmental pollutants; Ottawa, Canada (14 Jun 1971). See CONF-710668-.

Two power-generating plants put water from condenser-cooling systems into Lake Wabamun at temperatures 8 to 14°C above ambient. The input represents about 0.5% of the lake volume per day when averaged over the year. Circulation restricts the heated water to the east end of the lake, thereby localizing its effects. Infrared imagery has been used to support detailed direct thermometry. Discussed are the effects of heated effluent on planktonic algae, several species of macrophytes, five species of rotifers and four species of planktonic crustaceans. Noted in particular are the wide distribution of Elodea canadensis in the heated zone, concentration of Potamogeton pectinatus in the effluent canal, reduction in numbers of Diaptomus oregonensis in the heated zone, and variation in numbers and egg ratios for planktonic rotifers between the heated and unheated regions of the lake. (auth)

Chemical Effluents

Refer also to abstracts 2630 and 2909.

2672 (ANL/ES-CEN-1005) REDUCTION OF ATMOSPHERIC POLLUTION BY THE APPLICATION OF FLUIDIZED-BED COMBUSTION AND REGENERATION OF SULFUR-CONTAINING ADDITIVES. Annual Report, July 1971–June 1972. Vogel, G. J.; Carls, E. L.; Ackerman, J.; Haas, M.; Riha, J.; Schoffstoll, C. B.; Hepperly, J.; Jonke, A. A. (Argonne National Lab., Ill. (USA)). Jun 1973. Contract W-31-109-eng-38. 73p. (EPA-R-2-73-253). Dep. NTIS $5.45.

Fluidized-bed combustion is being studied as a means of removing from the gas phase nearly all of the atmospheric pollutants (sulfur and nitrogen compounds) generated during the combustion of fossil fuels. Particulate lime solids (additives) are introduced into the fluidized bed and react with the sulfur compound formed during combustion. Information has been obtained on (1) pollution control by fluidized-bed combustion of oil with an excess of air and by the combustion of coal with a deficiency of air, (2) the thermodynamics of several proposed processes for regenerating additives, and (3) experimental regeneration of sulfur-containing additive by the two most promising processes—a one-step reductive decomposition of $CaSO_4$ and a two-step (reduction-CO_2/H_2O regeneration) procedure. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 3141, 3162, 3169, 3241–3243, 4371–4373, 4376–4378, and 4477.

2673 (BARC-649) SLOW NEUTRON SCINTILLATORS FOR NEUTRON RADIOGRAPHY. Udyavar, R. S.; Jain, N. C.; Dande, Y. D. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

Neutron scintillators form an important class of neutron detectors in neutron radiography which is a relatively new technique for nondestructive testing. Scintillators were developed for thermal neutron radiography using boron/lithium as neutron detectors and various binding materials like glycerol, polythene and araldite. Response of these scintillators was determined experimentally with Indu x-ray film. Polythene bonded scintillators seem to be more rugged, reproducible, and homogenous. Radiographs obtained with these scintillators show that indigenous scintillators are fairly good for radiography work. (auth)

2674 (BIPM-68-5) RATIO OF TWO RANDOM VARIABLES AND THE SIMULATION OF THIS QUANTITY USING A MONTE CARLO METHOD. Mueller, J. W. (Bureau International des Poids et Mesures, 92–Sevres (France)). 1968. 6p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Various different measurements concern the ratio between two quantities. In the case of measurements requiring the accumulation of data over a comparatively long period (pulse counting), it is impossible to exceed a certain measurement time due to spurious effects. As a result, short measurement time intervals are used in which the two quantities are established alternately, consecutive ratios of the two quantities being determined from the measurements. It is shown that the probability density of the ratio between the two distributions corresponds to the Cauchy distribution. A Monte Carlo simulation is used to verify this behavior in the general case. (FR)

2675 (BIPM-68-8) REMARKS ON A METHOD SUGGESTED BY BAERG FOR MEASURING DEAD TIMES. Mueller, J. W. (Bureau International des Poids et Mesures, 92–Sevres (France)). 1968. 3p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The classical Moon method (1937) for measuring dead times consists of measuring the count rates of two radioactive sources, in the first place, separately, and then together. Recently Baerg proposed an interesting modification to this method in which one of the sources is replaced by an oscillator. In the case where the time intervals between the superimposed pulses are determined uniquely by the random pulses of the source, the accuracy required is attained in a period of time reduced by a factor of three in relation to the conventional method, in addition the result obtained no longer depends on the type of dead time (cumulative or noncumulative). It is demonstrated that this assumption is invalid and that in consequence modifications must be made to the simple formulas suggested by Baerg for determining the dead time. (FR)

2676 (BIPM-71-5) RANDOM PHENOMENA AND THE STATISTICS OF COUNTING. Mueller, J. W. (Bureau International des Poids et Mesures, 92–Sevres (France)). 1971. 5p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Three problems connected with counting radioactive sources are considered: distortion effects produced by dead times on the Poisson distribution, the possibility of experimentally studying the statistical properties of a series of pulses using a correlation method, and the importance of random coincidence pairs in the $4\pi\beta-\gamma$ coincidence counting method. (FR)

2677 (BIPM-72-3) TIME INTERVALS BETWEEN CORRELATED PULSES. Mueller, J. W. (Bureau International des Poids et Mesures, 92–Sevres (France)). 1972. 5p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

If the lifetime of the intermediate state is negligible for the detector employed, the two pulses resulting from a nuclear cascade decay arrive simultaneously. They can be recorded and separated using a coincidence circuit. If the time duration is similar to the resolving time or exceeds this time, the time ratios existing between the different radiations are used: e.g., the coefficient of correlation is measured for the process under consideration as a function of a variable delay. The time interval distribution between successive pulses is modified as a function of the mean life of the intermediate state. The empirical density of the successive intervals in a parent-daughter process is calculated using a Monte-Carlo type simulation. (FR)

2678 (BNL-18102) HEALTH PHYSICS AND SAFETY DIVISION ANNUAL PROGRESS REPORT, January 1–December 31, 1972. (Brookhaven National Lab., Upton, N. U. (USA)). 1 Aug 1973. 37p. Dep. NTIS $4.00.

Research topics outlined include a radiation monitoring and alarm system (Amcos II) for habitable areas of an accelerator complex; a digital environmental monitor; direct measurements of dose equivalent in aircraft; sampling and analysis of radioactive substances in the atmosphere; reactor effluents: as low as practicable or as low as reasonable; portable mixed radiation dose equivalent meter; minimizing surface dose with medium electron shields; environmental monitoring TLD studies; charcoal filter efficiency; semi-automatic film reader; radiation calibration facility; TLD extremity dosimeter; radiological assistance plan; secondary calibrator using Sr–Yβ's; automation of gamma spectroscopy; nanometer energy deposition studies; nanometer dosimetry using liquid scintillators; personnel dosimetry at the AGS; expected energetic secondary neutrons missing in 200 MeV proton water shield; and Halon 1301 fire tests. (WHK)

2679 (CONF-730324–, pp 21–23) SPECTRUM ANALYSIS BY NEUTRON DETECTORS. McCormack, G. 1973.

From ANS Niagara–Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

2680 (CONF-730915-7) PERSONNEL DOSIMETRY OF RADON AND RADON DAUGHTERS. Becker, K. (Oak Ridge National Lab., Tenn. (USA)). 1973. 12p. Dep. NTIS $3.00.

From symposium on noble gases; Las Vegas, Nevada, USA (24 Sep 1973).

During the past five years of increased interest in monitoring the individual exposure of persons to radon and, more importantly, radon progeny attached to aerosol particles, several devices have been proposed. These include the following: (a) passive detectors based on nuclear track emulsions and track etching foils; (b) semi-active systems in which the aerosols are collected electrostatically and detected by scintillator/film combinations or track etching; and (c) active systems based on the collection of aerosols on a filter, and integrating measurement of the alpha flux from the filter by TLD or track films. All these systems have drawbacks, which have been minimized in a small active system based on alpha particle track etching which was originally developed at ORNL in 1969. Since then it has undergone substantial laboratory and field testing, and has been subjected to various improvements. The system is briefly discussed. (auth)

2681 (COO-1671-49) TRACK STRUCTURE. Katz, R. (Nebraska Univ., Lincoln (USA). Dept. of Physics). 1973. 6p. (CONF-730804-2). Dep. NTIS $3.00.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

Once appropriately defined operational parameters of a detector have been measured, the theory predicts its response to an arbitrary radiation field. The model has found widest application to 1-hit-1 target detectors (scintillators, emulsion, enzymes, thermoluminescent dosimeters, and so on) and to 1-hit-many target detectors (bacteria and mammalian cells). The inherent non-linear response, and the inherent multiple valuedness of the response of 1-hit detectors to heavy ions suggest their application to the identification of z and β of energetic heavy ions passing through a pair of these detectors. (auth)

2682 (HEDL-SA-590) COMPARISON OF GAMMA IRRADIATION PERFORMANCE OF NEUTRON FISSION COUNTERS HAVING DIFFERENT ELECTRODE SPACINGS. Philipp, L. D.; Muhlestein, L. D.; Wood, M. R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 8 Oct 1973. Contract AT(45-1)-2170. 21p. Dep. NTIS $3.25.

A theoretical discussion concerning fission counter design and operation is presented. Tests were performed to show the effects of gamma fields on fission chambers having different electrode spacings and various argon-nitrogen fill gas mixtures and pressures. Based on these tests, the FFTF in-vessel fission counters will have 0.080-in. plate spacing and be filled with 1.75 atm of Ar-7% N_2. The electrode coating thickness will be 2 mg/cm^2 of U_3O_8 (93% ^{235}U enriched). (auth)

2683 (KHFTI-72-15) TECHNOLOGY OF PREPARATION AND CHARACTERISTICS OF SILICON–LITHIUM AND SURFACE–BARRIER DETECTORS OF NUCLEAR EMISSIONS.

Klyucharev, A. P.; Skakun, N. A.; Poryatui, V. S.; Dikii, N. P.; Zadvornyi, A. S. (AN Ukrainskoj SSR, Kharkov. Fiziko Tekhnicheskij Inst.). 1972. 26p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The technological operations used in making Si(Li) and surface-barrier detectors are discussed. Si(Li) detectors with a 4-mm-thick compensation zone and a 300-mm^2 area are described. Energy resolution is illustrated by spectra of alpha sources and elastic protons scattered on ^{12}C, ^{16}O, and ^{27}Al targets. (auth)

2684 (N-71-36493) DETERMINATION OF MEAN OPERATING LIFE AND SHELF LIFE FOR THE RADIATION SURVEY METER AND PERSONAL RADIATION DOSIMETER BATTERY PACKS. (General Dynamics Corp., Fort Worth, Tex. (USA). Convair Aerospace Div.). 31 Jul 1971. 32p. (NASA-CR-115189; FZK-382). NTIS.

Tests to determine the mean operating life of four types of battery packs for use in two types of Apollo radiation measuring instruments, the personal radiation dosimeter (PRD) and the radiation survey meter (RSM) were completed. This battery pack operating life test was conducted to determine if the battery packs presently being used in the PRD and RSM units on the short Apollo missions (10 days) would operate properly for the much longer (56 days) Skylab missions. The results of these tests proved conclusively that the presently used PRD battery pack containing eight BA-1006/U mercury cells will not operate properly for the 56-day Skylab mission, but these tests also show that a battery pack containing eight PX-625 mercury cells will operate throughout the Skylab mission. Results also show that the two RSM battery packs that now contain eight RM-625R mercury cells each will not operate the RSM properly for a 56-day Skylab mission and neither will any of the other three types of mercury cells tested. (auth)

2685 (NP-19847) TRACKS DISCRIMINATION OF LOW ENERGY NUCLEI IN PLASTICS. Internal Note 458. Baroni, G.; Di Liberto, S.; Petrera, S.; Romano, G.; Sgarbi, C. (Rome Univ. (Italy). Istituto di Fisica; Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 17 Apr 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50.

The efficiency of nitrocellulose plastic sheets as external detectors was studied as a function of impinging particle angle, energy loss rate, and other experimental conditions also in the presence of a high background of neutral and singly-charged particles. The discrimination among low-energy nuclei ($2 \le Z \le 6$) with a two step method of analysis was achieved with the definition of a parameter (w), connected with the measured etched length of the tracks, that assures their almost certain assignment to the various nuclear species. (auth)

2686 (RT/PROT-(73)17) REGISTRATION CHANGES OF DAMAGE TRACKS IN CELLULOSE DERIVATIVES. Casnati, E.; Marchetti, M.; Tommasino, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 16 Jun 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

The registration properties of the organic detectors depend on their morphological and chemical nature, which can be altered by uv and gamma exposures, thermal treatments, etc. The thermal treatment effects on damage track registration properties of the cellulose derivatives were studied. Data are presented to show how by simple thermal treatments it is possible to enhance the sensitivity of cellulose acetobutyrate and cellulose triacetate. When similar thermal treatments are applied to cellulose nitrate foils, they reduce mainly the bulk etching rate of such detectors. All these investigations indicate that the thermal history of these organic detectors represents an important parameter for their track registration characteristics. (auth)

2687 PHANTOM TO CORRECT THE IMAGE OF THE ANGER CAMERA. I. Nauber, G. (Zentralinstitut fuer Krebsforschung, Berlin). Isotopenpraxis; 9: No. 6, 208-213(Jun 1973). (In German).

Techniques for the production of an homogeneous phantom are proposed and proof is furnished that an homogeneous phantom ought to be recorded for each nuclide used for camera scintigraphy. Critical estimation of work with the homogeneous phantom on the camera is provided. The amount of work caused by the correction of the camera image is justified by the possibility of using the scintillation camera for the representation of organs. Due to the inhomogeneous sensitivity of the crystal-detector-system, the relative deviation of the non-corrected camera image ranges was ±15 per cent. Proof is furnished by means of an experiment that adjustment of electronics is not sufficient to obtain homogeneous sensitivity. (auth)

2688 CORRECTION OF THE ANGER CAMERA IMAGE. II. Nauber, G. (Zentralinstitut fuer Krebsforschung, Berlin); Markwardt, J.; Rosche, G. Isotopenpraxis; 9: No. 6, 213-215 (Jun 1973). (In German).

Based on the necessity of correction of the momentum distribution recorded by the scintillation camera proved in Part No. I, the correction calculation program is illustrated in the present work, taking into consideration the use of an electronic data processing technique. In the present stage of the development of a vast concept providing the use of EDP technique in scintigraphy – in which all the nuclear-medicinal institutions of the GDR take part – the authors are engaged with data input and output through punched tapes. The effect of the correction calculation is demonstrated on an homogeneous phantom as well as on a pancreas investigation. (auth)

2689 COUNTER CHARACTERISTIC RECORDER. Stange, E. Isotopenpraxis; 9: No. 8, 295-298(Aug 1973). (In German).

A recorder developed for the automation of counter characteristic registration is described. The operating mode and some features of wiring are shown. Input sensitivity may be chosen within a range between 10 and 200 mV. A high-voltage interval of 500 V is passed to plot a characteristic. The initial value of this interval may be chosen between 0 and 1,500 V. An electronic programming system renders possible automatic plotting of 1 to 9 characteristics of counters of the same type. The recorder is suitable for plotting characteristics of most counters of industrial manufacture. (auth)

2690 MODULATION TRANSFER FUNCTION OF 3″ AND 5″ COLLIMATOR-DETECTOR SYSTEMS OF SCANNERS. Ertl, S.; Tautz, M. (Staedtisches Klinikum, Berlin). Isotopenpraxis; 9: No. 5, 159-163(May 1973). (In German).

An explanation of the modulation transfer function as an important characteristic of a scintigraphic transfer system is given and is used to compare the resolution of 3″ and 5″ collimator-detector systems. The transfer functions are determined making use of line broadening functions. The behavior of the modulation transfer functions of several collimators of the 3″ and 5″ systems is discussed taking into consideration the distance between the source and the collimator. Furthermore, the $\lambda/2$ rule is used to supply data on the displayable detail size, and finally the equivalent band-width is indicated with regard to the different modulation transfer functions. (auth)

2691 APPLICATION OF A PATTERN RECOGNITION METHOD IN THE ANALYSIS OF EXPERIMENTAL DECAY CURVES. Kindler, E.; Prouza, Z. (Charles Univ., Prague). Isotopenpraxis; 9: No. 2, 47-49(Feb 1973).

The application of a computer method is demonstrated. The method is joined with a new branch of computer analysis called artificial intelligence. It has been applied to analysis of decay curves, where it needs no exact mathematical formulation of the problem and where it leads to very fast programs. (auth)

2692 THERMAL STABILITY OF TRACKS IN PLASTICS AND SOME USES IN RADIOGRAPHY. Somogyi, G. (Inst. of Nuclear Research, Debrecen, Hungary). Isotopenpraxis; 9: No. 7, 249-251(Jul 1973).

The eradication of alpha and fission tracks and the selective track discrimination by heat treatment have been studied in cellulose nitrate, cellulose acetate, and polycarbonate sheets. Some applications of the phenomena in alphagraphy and fissionography are presented. (auth)

2693 SCINTILLATION FLUIDS SUITABLE FOR THE COUNTING OF ISOTOPES IN SOLUTIONS CONTAINING PROTEIN. Simpson, E.; Browning, M. C. K. (Maryfield Hospital, Dundee, Eng.). Clin. Chim. Acta; 45: No. 2, 135-143(30 Apr 1973).

The problems of counting tritium and carbon-14 in solutions containing varying amounts of protein were studied and the limitations of various scintillation fluids described. Of the scintillation fluids assessed, those giving the highest counting efficiencies for solutions containing protein and the fewest problems with the formation of biphasic solutions, precipitates or crystals, were fluids containing the thixotropic gel Cab-O-Sil and the commercially available scintillation fluid Instagel. It is recommended that the limitations of any scintillation fluid be assessed before it is used routinely for biological samples and also that in all publications describing techniques involving the use of liquid scintillation counting systems details of the scintillation fluid should be given. (INIS)

2694 INTEREST IN THE CONVERSION INTO ABSOLUTE VALUE (DPM) OF THE RESULTS OBTAINED IN LIQUID SCINTILLATION. Trinon, J.; Thiret, E. (Univ., Liege). J. Radioanal. Chem.; 14: No. 1, 105-110(Mar 1973). (In French).

A procedure is presented for the conversion of rough results (cpm) obtained in liquid scintillation counting into absolute values (dpm). From the investigation of ten identical samples it has been shown that the samples statistically differ from each other when rough results are taken into consideration but with the obtained absolute values they are statistically identical. (auth)

2695 CURRENT MEASUREMENT AUTOMATION THROUGH VA-J-51 VIBRATING-REED ELECTROMETER. Guehne, F.; Rodloff, G. Isotopenpraxis; 9: No. 4, 121-123(Apr 1973). (In German).

Ionizing radiation measurement by means of ionization chambers as a rule yields current intensities ranging between 10^{-8} and 10^{-14} A. They can be measured by means of vibrating-reed electrometers, making use of the charging method. A stable working automatic arrangement is described by which two triggers and several commercial instruments renders possible convenient amperage measurements. The measured value of scattering caused by trigger variation and other factors ranges only two or three per mille, which fact may be fully utilized particularly with relative amperage measurement. The accuracy of amperage measurement itself mostly depends on the sensitivity of the vibrating-reed electrometer. (auth)

2696 UNEXPECTED DEADTIME LOSSES IN A MODIFIED RECTILINEAR SCANNING SYSTEM. Cooper, P. H.; Lerner, S. R.; Pircher, F. J. (Veterans Administration Hospital, Houston, TX). J. Nucl. Med.; 14: No. 11, 828-829(Nov 1973).

Larger than expected deadtime losses were experienced with a rectilinear scanner interfaced with a multichannel analyzer in part due to inability to use the built-in livetime clock. Correction factors developed experimentally for these losses are presented. (auth)

2697 WHOLE-BODY GAMMA CAMERA IMAGING USING A MOVING TABLE ACCESSORY. Lee, V. W.; Sano, R.; Freedman, G. (Yale Univ., New Haven). J. Nucl. Med.; 14: No. 11, 830-833 (Nov 1973).

The characteristics of a scintillation camera system for whole-body imaging are described. The advantages of decreased imaging time, reduced patient discomfort, and the ready intercomparison of different body areas on the same Polaroid film are presented. (auth)

2698 PROTECTION OF SOLID STATE DETECTORS FROM MERCURY. Hils, D.; McGregor, I. (Stirling Univ., Eng.). Rev. Sci. Instrum.; 44: No. 7, 911(Jul 1973).

A method is described to protect encapsulated solid state detectors from mercury vapor. This method is compared with an older procedure which was found to apply to nonencapsulated detectors only. (auth)

2699 EFFICIENCY CALIBRATION OF SEMICONDUCTOR DETECTORS IN THE X-RAY REGION. Hansen, J. S.; McGeorge, J. C.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Nucl. Instrum. Methods; 112: No. 1-2, 239-241(1973).

A method is outlined for the accurate determination of detection efficiencies of thin planar semiconductor detectors. The method involves experimental measurement of the detection efficiency, combining values obtained from standard sources with values obtained from two experimental techniques developed to provide a larger number of reliable experimental values. A theoretical model, independent of the measured efficiency, is then used to interpolate between experimental values. The reliability of the model is verified by an absolute comparison of the calculated efficiency with the experimental efficiency. The theoretical values for a typical intrinsic germanium detector are shown to agree within 3% with all experimental values between 6 keV and 60 keV. (auth)

2700 AFTERPULSES IN LIQUID SCINTILLATION COUNTERS. Williams, A.; Smith, D. (National Physical Lab., Teddington, Eng.). Nucl. Instrum. Methods; 112: No. 1-2, 131-135(1973).

The methods available for the detection of afterpulses are described and their relative advantages are compared. A brief review is given of some of the more recent experimental work on afterpulses in photomultipliers and liquid scintillation systems and the areas where it may be worthwhile carrying out further measurements are discussed. (auth)

2701 ELEMENTARY MECHANISMS IN LIQUID SCINTILLATION COUNTING. Klein, J. (Univ. Louis Pasteur, Strasbourg). Nucl. Instrum. Methods; 112: No. 1-2, 117-120(1973).

Scintillation efficiency and decay in a liquid scintillator are determined by the electronic properties of the solvent and solute molecules. An ionizing particle interacting with the solvent initiates a complex sequence of processes including plasmon excitation and decay, ion formation and recombination, and production of excited states with ultimate energy transfer to the fluorescent solute molecules. Our current knowledge of these elementary mechanisms is presented, considering aromatic and aliphatic solutions. (auth)

2702 PRESENT STATUS IN THE FIELD OF PRECISION LIQUID SCINTILLATION COUNTING. Vaninbroukx, R. (EURATOM, Geel, Belgium); Stanef, I. Nucl. Instrum. Methods; 112: No. 1-2, 111-116(1973).

First, a short review of some general aspects, e.g., basic mechanisms, scintillators, instrumental developments, and source preparation is given. Then, the applicability and the attainable accuracy of the liquid scintillation method for absolute measurements of the activity of β-emitters of different energy, α-emitters, and EC-nuclides are discussed. The different techniques used are described: extrapolation of the bias curve to zero bias, correction for non-detection probability, and 4π β-γ coincidence counting and efficiency tracing using liquid scintillators as β-detectors. Finally, some special applications in the field of radionuclide metrology and the suitability of liquid scintillation counters for relative radioactivity measurements by Cherenkov radiation detection are reviewed. (81 references) (auth)

2703 SELECTED PROBLEMS IN THE FIELD OF PROPORTIONAL COUNTERS. Bambynek, W. (EURATOM, Geel, Belgium). Nucl. Instrum. Methods; 112: No. 1-2, 103-110(1973).

A brief review is given on some parameters and physical effects which influence the mechanism of proportional counters. The following topics are discussed: gas amplification, space charge, recombination, ion and electron transit times, efficiency of counters operated at high pressure. (70 references) (auth)

2704 HIGH-PRESSURE 4π PROPORTIONAL COUNTER FOR INTERNAL CONVERSION ELECTRON MEASUREMENTS (^{139}Ce, ^{109}Cd, ^{99m}Tc). Legrand, J.; Blondel, M.; Magnier, P. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Instrum. Methods; 112: No. 1-2, 101-102(1973).

A high-pressure 4π proportional counter is described. Its usefulness for measurement of conversion electrons is demonstrated. New values for the internal conversion coefficients in the decay of ^{139}Ce, ^{99m}Tc and ^{109}Cd are reported. (auth)

2705 SPURIOUS PULSES IN PROPORTIONAL COUNTERS. A Review. Campion, P. J. (National Physical Lab., Teddington, Eng.). Nucl. Instrum. Methods; 112: No. 1-2, 75-81(1973).

The present state of knowledge of spurious pulses in proportional counters is reviewed. The main emphasis is on the time distributions obtained rather than on the methods by which such pulses may be detected. Some observations on the use of the present data are also given. (auth)

2706 SINGLE ELECTRON DETECTION IN PROPORTIONAL GAS COUNTERS. Genz, H. (Ruhr-Univ., Bochum, Ger.). Nucl. Instrum. Methods; 112: No. 1-2, 83-90(1973).

By releasing single electrons with insufficient energy to produce immediate ionization it has proved possible, experimentally, to study individual avalanche distributions in isolation from confusing effects arising from fluctuations in the number of primary ion pairs. The study of the development of avalanches from a single pair of ions is not only of importance for a complete understanding of the detection mechanism in gas-filled proportional counters but also for the detection of soft x-rays, uv radiation and electrons of essentially zero energy. Several experimental studies that have been carried out within the recent years are discussed. Pulse spectra produced by the release of single primary electrons in a proportional counter have been measured for a variety of gas fillings, gas mixtures and anode voltages. A brief survey of different theoretical approaches of avalanche formation in proportional counters is included. For low values of E/p the pulse spectrum produced by single electrons decreases exponentially with increasing pulse height. At high field and low pressure the distributions have pronounced maxima. Modifications to the theoretical distribution can account for deviations from the exponential form. When secondary processes become significant, avalanche breeding may take place and avalanche chains are detected and the distribution of the electron number in the total charge pulse may be altered. (auth)

2707 PULSE HEIGHT DISTRIBUTION IN LOW ENERGY PROPORTIONAL COUNTER MEASUREMENTS. Breyer, B. (Rudjer Boskovic Inst., Zagreb). Nucl. Instrum. Methods; 112: No. 1-2, 91-93(1973).

The pulse height distribution in proportional counters produced by primary radiations of very low energy is discussed. (auth)

2708 PRESSURIZED PROPORTIONAL COUNTERS FOR COINCIDENCE MEASUREMENTS. Baerg, A. P. (National Research Council, Ottawa). Nucl. Instrum. Methods; 112: No. 1-2, 95-99(1973).

The experimental requirements for absolute measurements by 4π $\beta\gamma$-coincidence counting with efficiency variation are outlined. In this context the use and operating characteristics of a pressurized 4π β-proportional counter are considered. Basically, when the counter is pressurized, energetic β-particles deposit a larger fraction of their energies in the sensitive volume. The added property of proportionality then permits efficiency variation by low energy discrimination. This is especially advantageous for measurements on complex β-γ decay, electron capture and mixed radiations. (auth)

2709 CORRELATION TECHNIQUES IN RADIOACTIVITY MEASUREMENT. Williams, A.; Lewis, V. E.; Smith, D. (National Physical Lab., Teddington, Eng.). Nucl. Instrum. Methods; 112: No. 1-2, 285-289(1973).

The basis of the correlation method is described and the relevant formulae for three different applications of the method are derived. Case 1 gives a simple description of the method by applying it to the analysis of events from a single detector. Case 2 shows how the method can be used to determine the fractional number of time correlated pulses in a detector system, e.g., pulses arising from delayed states. Case 3 shows how the method can be used to determine the coincidence rate between two detectors for two distinguishable radiations in cascade. The relative advantages and disadvantages of the method compared with the normal counting techniques are discussed in detail for each case. (auth)

2710 4πγ-IONIZATION CHAMBER MEASUREMENTS. Weiss, H. M. (Physikalisch-Technische Bundesanstalt, Brunswick). Nucl. Instrum. Methods; 112: No. 1-2, 291-297(1973).

A short review is given of the present state of activity determinations by means of 4π γ-ionization chambers. Precautions and corrections essential to get a precision of better than 0.1% are discussed. Different methods used for ion current measurements are treated. (auth)

2711 PRECISE MEASUREMENT OF SMALL CURRENTS. Zsdanszky, K. (National Office of Measures, Budapest). Nucl. Instrum. Methods; 112: No. 1-2, 299-303(1973).

In radioactivity measurements using ionization chambers the currents to be measured range from 10^{-7} A to 10^{-13} A, depending on the radionuclides and their activities. There are two techniques for measuring small currents: the shunt-type and feedback-type. In comparing shunt vs feedback picoammeters, both speed and input resistance considerations indicate that the feedback-type offers superior performance. Small currents can also be measured by current integration. Two methods are used for collecting charges on a known capacitor and measuring the voltage. The first uses an electrometer as a voltmeter with a capacitor shunting the input. The second incorporates the capacitor into the feedback of the electrometer. Errors due to leakage current of the integrating capacitor can be automatically compensated for. (auth)

2712 LOW-LEVEL RADIOACTIVITY MEASUREMENTS. Hutchinson, J. M. R. (National Bureau of Standards, Washington, DC); Mann, W. B.; Perkins, R. W. Nucl. Instrum. Methods; 112: No. 1-2, 305-318(1973).

Low-level radioactivity measurements are reviewed. Alpha- and β-particle, and γ-ray low-level-radioactivity counting is discussed, and various detector systems are compared for detection sensitivity. Low-level measurements on bovine liver standard reference material, and radioactive contamination in industrial samples of aluminum, copper, and steel are reviewed. The results of low-level radioactivity intercomparisons are discussed. (auth)

2713 MULTIWIRE COUNTING. Pahor, J.; Hribar, M. (Univ. of Ljubljana, Yugoslavia). Nucl. Instrum. Methods; 112: No. 1-2, 279-283(1973).

The application of multiwire counters instead of the corresponding cylindrical proportional counter in low-level gas counting, electron-capture studies and fluorescence-yield determinations is discussed. By studying the spectrometric properties of the ring counter the possible deterioration of the energy resolution due to a deviation of the electric field around the counting wires from axial symmetry was estimated as negligible. (auth)

2714 STATEMENT OF RESULTS OF EXPERIMENTS AND THEIR ACCURACY. Williams, A.; Campion, P. J.; Burns, J. E. (National Physical Lab., Teddington, Eng.). Nucl. Instrum. Methods; 112: No. 1-2, 373-376(1973).

A procedure for the assessment and statement of uncertainty of an experimental result is discussed. The uncertainty is divided into two categories, the random uncertainty, which is derived by normal statistical methods and the systematic uncertainty, which is derived from an assessment of the characteristics of the equipment and method used. The combination of the component uncertainties in each category and the possibility of combining the two types of uncertainty to obtain an overall uncertainty are discussed. It is concluded that the final statement should give the random and systematic uncertainties separately, together with sufficient information to allow significance tests to be carried out. (auth)

2715 STATISTICAL METHODS APPLICABLE TO COUNTING EXPERIMENTS AND EVALUATION OF EXPERIMENTAL DATA. Ku, H. H. (National Bureau of Standards, Washington, DC). Nucl. Instrum. Methods; 112: No. 1-2, 377-383(1973).

In an experiment, a sequence of operations was performed that resulted in the collection, interpretation, and transmission of information on a topic of interest. Statistical methodology was used to help in increasing the efficiency of collection, in checking the validity of interpretation, and in editing the presentation of results. Some such concepts and methods that are useful to counting experiments, and essential to the operations of standards and calibration laboratories, are discussed. (auth)

2716 TREATMENT OF ERRORS IN LOW-ACTIVITY MEASUREMENTS. Hilaire, M. (CEN, Saclay, France). Nucl. Instrum. Methods; 112: No. 1-2, 383-390(1973).

In low-activity metrology, systematic errors are often negligible with respect to the random error related to the irregularity of the disintegrations. The determination of the confidence limits around the mean is studied allowing for the appropriate distribution law: Poisson or normal distribution. From these factors are defined working conditions for various methods of relative and absolute measurements. The experimental conditions of relative and absolute low-activity measurements are defined and optimised on the basis of these considerations. (auth)

2717 PROPORTIONAL AND SCINTILLATION COUNTERS USED IN COINCIDENCE COUNTING. Bek-Uzarov, D. N. (Boris Kidric Inst., Belgrade). Nucl. Instrum. Methods; 112: No. 1-2, 201-208(1973).

The accuracy of measurements by coincidence method depends on the efficiency of the counters that are used and their stability during measurements. Attention is paid to the problems of the reproducibility of measurements of both proportional and scintillation counters independently. Construction details of proportional counters are discussed and some advantages in counting characteristics of an event counter are presented. Using negative temperature resistors in the voltage divider of the photomultiplier, a compensation of the total amplifier factor was realized and a plateau of the scintillation counter obtained. (auth)

2718 SAMAR SHARED-DEAD-TIME METHOD. A New Approach to Beta-Gamma Coincidence Counting. De Carlos, J. E.; Granados, C. E. (Junta de Energia Nuclear, Madrid). Nucl. Instrum. Methods; 112: No. 1-2, 209-212(1973).

In a conventional β-γ coincidence counting system, the partially correlated β and γ series of pulses with their associated chain dead times, $(\tau_\beta, \tau_\gamma)$, give place to an overlapping process on the coincidence channel, whose transmission factor $\phi(A_\beta, \tau_\beta, \tau_\gamma)$ becomes poorly defined for the general case. In this context, the "Shared-Dead-Time" (SDT) system has been conceived to impose a total time correlation between both chains blocking intervals by inserting simultaneously a common dead-time from a single paralysis generator which is triggered by the pooled counting pulses. As a result, identical transmission factors are obtained for the three counting channels. The extra cost in counting losses is well compensated by a good definition of dead-time for coincidences whose two first moments of its interval density get known. A novel dead-time circuit using fast linear gates as blocking elements and post-integration into the paralysis loop is introduced as an option for high count rates. The "SAMAR" instrumentation system incorporates a single "live-time" 1 MHz quartz clock and automatisms. The SDT system has been tested by Müller's two-oscillator method, slightly modified. Preliminary results proved the non-extending character of the new dead-time circuit and the working ability of the SDT two-branch loop. (auth)

2719 NATIONAL BUREAU OF STANDARDS 4π β-γ COINCIDENCE COUNTING AND X-RAY INTERCOMPARATOR AUTOMATIC SAMPLE CHANGERS. Garfinkel, S. B.; Mann, W. B.; Pararas, J. L. (National Bureau of Standards, Washington, DC). Nucl. Instrum. Methods; 112: 213-217(1973).

Instruments of very simple and somewhat novel design are described. The 4π β-γ changer holds from 1 to 30 carriers of sources, each of which can be counted for any preset number, up to ten, of counting periods. The γ-ray changer accommodates from one to 24 source carriers. In comparing γ-ray source count rates, the detector-to-source distances for individual sources are carefully controlled. (auth)

2720 CURRENT STATE OF THE ART IN SEMICONDUCTOR DETECTORS. Bertolini, G.; Cappellani, F.; Restelli, G. (Joint Nuclear Research Center, Ispra, Italy). Nucl. Instrum. Methods; 112: No. 1-2, 219-228(1973).

The highlights of the current state of the art in semiconductor radiation detectors are reviewed. Most attention is devoted to hyperpure-germanium and compound semiconductors. Only a brief account of the most impressive achievements obtained in Si(Li) and Ge(Li) detectors is then given. Present and future role of compound semiconductors and their competition with germanium are discussed. (68 references.) (auth)

2721 PRESENT STATUS IN THE FIELD OF INTERNAL GAS COUNTING. Garfinkel, S. B.; Mann, W. B.; Schima, F. J.; Unterweger, M. P. (National Bureau of Standards, Washington, DC). Nucl. Instrum. Methods; 112: No. 1-2, 59-67(1973).

The gas-counting equipment at the National Bureau of Standards has been recently modified and reconstructed. The preparation of various radioactivity gaseous standards is described. In some cases purity is assured by a prior separation in the isotope separator. (auth)

2722 DEAD-TIME PROBLEMS. Mueller, J. W. (Bureau International des Poids et Mesures, Sevres, France). Nucl. Instrum. Methods; 112: No. 1-2, 47-57(1973).

The usual two types of dead times, extended and non-extended, are reviewed and fundamental properties of their effect on the interval distribution and the count rate are discussed briefly. The application of renewal theory to counting processes is sketched and it is shown how the interval distribution, which is distorted by the presence of a dead time, can be used to determine the resulting counting statistics. In particular, the modifications of an original Poisson process, due to a non-extended dead time, are indicated for the case where the origin of the measuring interval has been chosen at random. A simple application then shows the fallacy of the so-called zero-probability analysis. When renewal processes are superimposed, their convolution property is lost. Therefore, a general formula for the density of multiple intervals is given for the superposition of two component processes. These results have proved useful for studying two recently reported methods of measuring dead times. Finally, formulae are given for the four different ways of arranging two dead times in series. The review is confined to one-channel problems and the emphasis is on exact results. (auth)

2723 WORK OF THE BIPM CONSULTATIVE COMMITTEE FOR MEASUREMENT STANDARDS OF IONIZING RADIATIONS. Section II: Radionuclide Measurements. Campion, P. J. (CCEMRI, Sevres, France). Nucl. Instrum. Methods; 112: No. 1-2, 41-45(1973).

A brief account of the activities, both past and present, of this Committee is presented. The aim is the improvement of the accuracy and uniformity of radioactivity measurements. To date the Committee has organized 11 international comparisons and the results of some of these are examined. While these have revealed some systematic errors in measurement techniques, the results of the more recent comparisons have been disappointing in that the knowledge gained has been small in relation to the effort involved. In view of this a different approach has been adopted. The Committee has set up a number of small working groups to study various aspects of radionuclide metrology where discrepancies may perhaps occur. It is hoped that, at least for a number of such studies, a monograph will be published highlighting the measurement difficulties. Until such monographs are available there is, in the Committee's view, little point in carrying out further international comparisons. However, in order to fill a need created by this temporary moratorium, the Bureau International des Poids et Mesures has offered to both provide calibrated solid sources and train staff in radionuclide metrology. (auth)

2724 SOME GENERAL ASPECTS OF RADIOACTIVITY MEASUREMENT METHODS. Spernol, A. (EURATOM, Geel, Belgium). Nucl. Instrum. Methods; 112: No. 1-2, 23-31(1973).

In the first part, the consequences of the statistical nature of radioactivity are reviewed from a systematic point of view. Especially the limitations to and possibilities for radioactivity measurements due to its statistical feature are discussed. In the second part it is tried to classify all measurement methods systematically and to review them according to some appropriate basic criteria. Finally the fundamental conditions required for very accurate measurements are shortly reviewed. (107 references) (auth)

2725 COMPARATIVE STUDY OF THE BAIRD-ATOMIC IMAGING DEVICE AND THE CHICAGO NUCLEAR CAMERA. Desgrez, A.; Ribot, J.; Charreire, Y.; Nicolle, D. (CEN, Orsay, France). pp 422-428 of Fourteenth Colloquium on Nuclear Medicine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French).

From 14th colloquium on nuclear medicine. Vol. 3; Tours, France (9 Jun 1972).

The studies presented concern the behavior of an imaging device used in routine scintiscanning measurements in a functional exploration laboratory. A scintillation camera Nuclear-Chicago Pho-Gamma III (a device having known characteristics) was used for comparison purposes. The results obtained using the imaging device are disappointing, especially those concerning the resolving power and the absence of spectrometry. The results obtained using the apparatus with β^+ emitters were also disappointing. (FR)

2726 INFLUENCE OF COMPOUNDS OF THE 1,4-BENZODIOXANE SERIES ON THE DETERMINATION OF THE ^{14}C ISOTOPE IN LIQUID SCINTILLATORS. Paeda, R. I.; Visotskaite, S. B.; Poshkute, Z. A. (Vilnyus State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; No. 11, 145-150(1970). (In Russian).

The effect of compounds of the 1,4-benzodioxane series on the determination of the relative radioactivity of ^{14}C isotopes in liquid scintillators was studied. The dependence of the efficiency of the determination of the ^{14}C isotope on the concentration of the compounds and on their chemical structure was established. It was determined that 5-[β-(β'-oxyethoxy)-ethoxy]-1,4-benzodioxane increases the efficiency of the determination of the ^{14}C in PPO scintillation by 14.9%, 5-(β-ethoxyethoxy)-1,4-benzodioxane in the p-terphenyl scintillator by 30.0%, and 5-[β-(β'-oxyethoxy)-ethoxy]-1,4-benzodioxane in PPO + POPOP scintillators by 4.5%. (tr-auth)

2727 NUCLEAR-RADIATION DETECTORS BASED ON HIGH PURITY GERMANIUM. Aver'yanova, V. P.; Ginzburg, M. I.; Strokan, N. B.; Subashieva, V. P.; Tisnek, N. I. At. Energ. (USSR); 34: No. 6, 483-485(Jun 1973). (In Russian).

Germanium detectors stable at room temperature can be obtained by cold alloying, that is, the working of the detector is formed by compensating the initial conductivity by means of deep acceptor levels associated with radiation defects. It is evident that the smaller the difference concentration of impurities (N_D-N_a) in the initial germanium, the smaller is the number of defects required for compensation and the smaller are the undesirable effects of current carrier capture on the implanted deep levels. Hence serious efforts were undertaken to obtain high-purity germanium to be used in detectors of high quality without the necessity of additional compensation. Germanium was purified by zone melting, and the results of using this high-purity material in detectors were the following: difference concentration of carriers (at 77°K) 8×10^{10} cm^{-3}, type of conductivity (at 77°K) p, conc. of donors N_D 3.3×10^{11} cm^{-3}, conc. of acceptors N_a 4.1×10^{11} cm^{-3}, total conc. of donors and acceptors ($N_D + N_a$) 7.4×10^{11} cm^{-3}, degree of compensation 80%, mobility μ (at 77°K) 3.9×10^4 cm^2/volt · sec. Uncompensated impurities and their concentrations were: boron 1.1×10^{10} cm^{-3}, aluminum 5×10^{10} cm^{-3}, gallium 1.9×10^{10} cm^{-3}, dislocation density 5×10^2 cm^{-2}. Energy resolutions for Cs-137 gamma on three detectors were 0.2, 0.5 and 0.7% respectively. The energy resolution for Am-241 alpha was 0.6%, and 0.7% for 1.0 MeV beta. The average losses of charge collection were 0.15, 0.3 and 0.4% respectively. The average sensitive area of these detectors was 1.6 cm^2. Further purification from impurities is required to obtain detectors having a large volume of sensitive region. (SJR)

2728 ANOMALOUS IONIZATIONS CAUSED BY RECOIL ATOMS FROM NEUTRONS WITH $E_n \geq 20$ KeV IN PROPORTIONAL COUNTERS. Bergman, A. A.; Malikzhonov, A. (Lebedev Inst. of Physics, Moscow). pp 290-294 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From All-Union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

It is observed that recoil atoms due to neutron scattering in proportional counters produce anomalously high ionization. The effect depends on small impurities in counter gases (less than 10^{-3}%). (4 figures) (auth)

2729 COLLIMATOR OF MULTIPLE PLATES WITH AXIALLY ALIGNED IDENTICAL RANDOM ARRAYS OF APERTURES. Hoover, R. B.; Underwood, J. H. (to National Aeronautics and Space Administration). US Patent 3,749,911. 31 Jul 1973. Filed Date 30 Jun 1970. 6p.

A collimator is disclosed for examining the spatial location of distant sources of radiation and for imaging by projection, small, near sources of radiation. The collimator consists of a plurality of plates, all of which are pierced with an identical random array of apertures. The plates are mounted perpendicular to a common axis, with like apertures on consecutive plates axially aligned so as to form radiation channels parallel to the common axis. For near sources the collimator is interposed between the source and a radiation detector and is translated perpendicular to the common axis so as to project radiation traveling parallel to the common axis incident to the detector. For far sources the collimator is scanned by rotating it in elevation and azimuth with a detector to determine the angular distribution of the radiation from the source. (Official Gazette)

2730 METHOD OF STUDYING THE ENERGY AND ANGULAR DISTRIBUTIONS OF CHARGED PARTICLES WHICH DEVELOP IN THE SUBSTANCE OF A DETECTOR. Kuritsyn, V. N. (Leningrad Technological Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 708-710(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 47-49(1973).

A method is proposed for the simultaneous study of the energy and angular distributions of charged particles which develop in the substance of a detector. Thin plates that record the energy of only those reaction products whose emission direction lies in the detector plane are used as the detectors. It is shown that if the experimental function of the nuclear reaction yield as a function of the angle at which the detector is set relative to the primary beam is known, then it is possible to reconstruct the angular distribution function with an accuracy of up to the sum $\sigma(\theta) + \sigma(\pi - \theta)$. The possibility of using a thin silicon semiconductor detector for this purpose is evaluated. (auth)

2731 LOW-BACKGROUND TELESCOPE OF COUNTERS FOR RECORDING ALPHA-PARTICLES IN (n,α)-REACTIONS. Dolya, G. P.; Bozhko, V. P.; Tutubalin, A. I. (Physical-Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 716-719(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 54-56(1973).

A telescope of counters is described for the recording of α-particles in reactions that are caused by fast neutrons. The telescope consists of four proportional counters and one scintillation counter. The scintillation counter and three proportional counters are connected for coincidence, while the fourth proportional counter, which is situated in front of the target, is connected for anticoincidence with the four remaining counters in order to suppress the background from the front wall of the telescope and from the crystal of the scintillation counter. The achieved effect/background ratio is several times as good as it is for a telescope consisting of two proportional counters and one scintillation counter. The described equipment is used to study the angular and energy distributions of α-particles in (n,α)-reactions. (auth)

2732 INTRODUCTION OF LARGE AMOUNTS OF LITHIUM INTO NUCLEAR PHOTOGRAPHIC PLATES. Kotikov, E. A.; Makhnovskii, E. D. (Leningrad Inst. of Nuclear Physics). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 736-737 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 70-71(1973).

A simple method of introducing lithium acetate into thick-layer photographic plates is described, which does not require a rigorous temperature mode and is economical in the expenditure of deficit lithium isotopes. The method allows up to 75 mg of ^{7}Li/cm^3 to be introduced and ensures prolonged exposure times of nuclear photographic plates in a vacuum. (auth)

2733 ABSOLUTE ENERGY CALIBRATION OF LOW-PRESSURE PROPORTIONAL COUNTERS CONTAINING HYDROGEN. Konyushkov, A. G.; Korolev, V. I.; Savinskii, A. K.; Filyushkin, I. V. (Inst. of Biophysics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 738-741(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 71-74(1973).

An operative method is proposed for the absolute energy calibration of low-pressure counters containing hydrogen which are designed for the spectrometry of neutron radiation in the energy range from 5 to 200 keV. The method is based on comparing the calculated spectrum of energy evolution of ^{3}He(n,p)T-reaction products in the sensing volume of the detector with the experimental amplitude distribution of pulses that develops when the detector is irradiated with thermal neutrons. (auth)

2734 CONSIDERATION OF THE INTERACTION OF THE PRODUCTS OF THE ^{3}He(n,p) REACTION WITH THE WALL IN SPHERICAL PROPORTIONAL COUNTERS. Andreeva, L. S.; Bol'shakov, A. V.; Savinskii, A. K.; Filyushkin, I. V. (Inst. of Biophysics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 742-744(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 75-77(1973).

Results are described of calculating the shape of the line of the ^{3}He(n,p) reaction in spherical counters. It is shown that in order to construct the shape of the energy-release spectra of the products of the ^{3}He(n,p) reaction with allowance for the finite dimensions of the sensing volume of a ^{3}He spherical counter, one can use approximate analytic relationships with a sufficient degree of accuracy without resorting to calculation according to the Monte-Carlo method. (auth)

2735 AMPLITUDE OF THE PULSE IN A HIGH-PRESSURE CORONA COUNTER CONTAINING ^{3}He. Korolev, V. I. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 745-746(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 77-78(1973).

The dependence of the amplitude of pulses in a corona counter containing ^{3}He was investigated in the pressure range 2 to 12 atm at various Ar concentrations. (auth)

2736 CURRENT CONNECTION OF COMPACT LOW-VOLTAGE HALIDE COUNTERS. Vakulov, P. V.; Belyakov, S. A.; Butenko, B. D.; Shcherbovskii, B. Ya. (Scientific Research Inst. of Nuclear Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 747-749(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 79-80(1973).

The current circuit configuration of compact low-voltage halide counters allows the discharging capacitance of the counter combined with the transistor circuits to be reduced by almost one order, and the operating service life of the counter to be correspondingly increased. Two transistor circuits of input amplifier-shapers are presented which are being used successfully in the current circuit configuration of the SBT-18 and SBM-10 counters. (auth)

Radiation Dosimeters

Refer also to abstract 3166.

2737 (BNL-18219) NANOMETER DOSIMETRY OF HEAVY ION TRACKS. Baum, J. W.; Varma, M. N.; Wingate, C. L.; Paretzke, H. G.; Kuehner, A. V. (Brookhaven National Lab., Upton, N. Y. (USA)). 11 Sep 1973. 23p. (CONF-730952-1). Dep. NTIS $3.25.

From 4th symposium on microdosimetry; Pallanza, Italy (24 Sep 1973).

The radial distribution of ionization around heavy ion tracks was measured using a unique variable pressure ionization chamber containing a movable screen walled probe chamber. Measurements were made at pressures and distances which correspond to distances in tissue of a few Å to a few thousand Å using 38.4 MeV ^{16}O, 33.25 MeV ^{127}I and 61.9 MeV ^{127}I ions. Results are compared to theoretical calculations. An equation which adequately summarizes the data out to radii which include 95% of the total energy lost by the primary particles is: $D(r) = C \cdot Z^2 \cdot (E/m)^{-1} \cdot r^{-2}$, where D(r) is dose (ergs/gm), at radius r(Å of unit density tissue-like material), for particles of energy E (MeV), mass m (amu), effective charge Z and C is a constant. Calculations and experiment are in general agreement with this equation. The deviations between experimental data and theoretical calculations are explained in terms of charge nonequilibrium for small radii. Gas atom scattering and Auger electron production from incident heavy ions explain deviations from theory at large radii. (auth)

2738 (EUR-5041) PERFORMANCE OF FISSION TRACK DOSIMETER FOR MONITORING THE NEUTRON RADIATION FROM ^{252}Cf SOURCES ON HANDS INSIDE GLOVE BOXES. Mijnheer, B. J. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Oct 1973. 49p. Dep. NTIS (U. S. Sales Only) $4.50. EUR B.Fr. 60.-.

A description is given of a personnel neutron dosimeter based on fission track registration in a 10 μm thick Makrofol foil in combination with two thorium discs, for use on the hands of operators during the handling of ^{252}Cf sources inside glove boxes or during implantation work for therapy purposes. The device also contains a TLD-100 chip for measuring the γ-dose equivalent on the hand. The angular dependence of the response of the dosimeter with thorium and other fissile materials was measured at different energies. The neutron sensitivity of the dosimeter was determined with a calibrated ^{252}Cf source and amounts to 14.9 ± 0.7 mrem/spark^{-1}. The neutron spectrum scattered inside the glove box was measured. The resulting dose equivalent; which will not be recorded by the dosimeter, amounts to about 50 mrem.hr^{-1} per μg ^{252}Cf, and is not very dependent on the distance to the source. Experience with the dosimeter over a period of about one year at CBNM shows that the ratios of the gamma dose on the finger tip to that on the hand and the gamma to neutron dose equivalent at the place of the dosimeter varies considerably. (auth)

2739 (NVO-410-9) NTS PERSONNEL DOSIMETER: NAD SYSTEM. Wells, I. J. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, Nev. (USA). Environmental Sciences Dept.). Dec 1972. Contract AT(26-1)-410. 59p. Dep. NTIS $5.45.

The neutron dosimetry system incorporated in the NTS personnel dosimeter and the method of using it for nuclear accident dosimetry (NAD) are described. Details of the calibration procedure are given. Some useful cross sections and other detailed data are tabulated. (auth)

2740 (RT/PROT-(73)11) CALIBRATION BY COMPARISON OF THE USUAL CAPACITY IN IONOMETRIC MEASUREMENTS. Zapparoli, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 31 Mar 1973. 24p. (In Italian). Dep. NTIS (U. S. Sales Only) $3.25.

The evaluation of absorbed dose of ionizing radiation by ionometric methods as well as the measurement of exposures requires an accurate determination of ionization currents. Such evaluation is performed by means of electrometric devices where a condenser which integrates the ionic current is the main component. An analysis of the most suitable methods for calibrating a condenser capacity is presented. From this analysis many useful directions are drawn to carry out an accurate ionometric measurement. The error sources are thoroughly investigated and both random and systematic errors are determined. (auth)

2741 DETERMINATION OF SCATTERED RADIATION COMPONENT AND DIAPHRAGM PENETRATION CORRECTION FACTORS FOR ABSOLUTE DETERMINATION OF EXPOSURE UNIT WITH ENERGY RANGING FROM 0.6 TO 2.0 MeV. Kunze, R. Isotopenpraxis; 9: No. 7, 264-268(Jul 1973). (In German).

The determination of correction factors for the scattered radiation component (K_{St}) and the diaphragm penetration (K_B) is discussed with regard to standard gauges used for exposure unit determination. The formula derived for K_{St} may be transformed to standard chambers of any size. The K_B ratio is applicable to diaphragms having cylindrical orifice. The values of the factors K_{St} and K_B refer to the ASMW standard gauge. (auth)

2742 ABSOLUTE CALIBRATION METHODS OF GERMICIDAL ULTRAVIOLET DOSE-RATE METERS. Vechet, B. (Inst. of Microbiology, Prague). Stud. Biophys.; 36-37: 51-57(1973).

From international conference on the bases of the biological effects of ultraviolet radiation; Brno, Czechoslovakia (2 Oct 1972).

Problems of absolute measurement of the intensity of ultraviolet radiation of germicidal lamps in energetic units were studied. Three Pen Ray SC-1 low-pressure mercury lamps were measured independently in different laboratories using different instruments: (a) Westinghouse SM-600 meter, (b) General Electric Germicidal Meter, and (c) large surface thermopile with a Backstrom filter. These lamps were then used as standards of absolute irradiance at wavelength of 2537 Å and compared with the Latarjet dosimeter and the IL-254 germicidal photometer. A mutual agreement of calibration coefficients of three standard Pen Ray SC-1 lamps was within 5% error. A direct radiometric calibration using an FT-16 Schwarz-Hilger vacuum thermopile was in good agreement with the above comparison. The Latarjet dosimeter exhibited a value lower by 30%. UV inactivation of the bacteriophage T 2 with D_{37} equalling 28 erg/mm^2 and the bacteriophage ϕX-174 with D_{37} of 110 erg/mm^2 was determined on the basis of the above calibration. (auth)

2743 INTENSITY MEASUREMENTS OF BREMSSTRAHLUNG IN THE 200 TO 10 eV REGION. Mueller-Sievers, K. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). Biophysik; 10: No. 2, 163-175(1973). (In German).

Thermoluminescence in LiF single crystals offers the possibility of measuring the intensity of bremsstrahlung with energies down to about 13.5 eV. An apparatus was developed which permits the production of sufficiently intense x-ray continua with voltages of 600 to 10 V. The high sensibility of LiF also for low-energy radiation made it possible to study the relation between the intensity of the ultrasoft x-ray continuum and the tube voltage. The past experimental and theoretical studies showed varying results in this respect. The results of the present experiments allow the conclusion that the integral intensity of extremely low-energetic bremsstrahlung produced in solid-state anodes is proportional to the square of effective tube voltage, i.e., the kinetic energy of the electrons striking the anode. (auth)

2744 RADIATION-EXCITED EXOELECTRON EMISSION OF LiF. Mueller, F. (Technical Univ., Dresden). Isotopenpraxis; 9: No. 2, 68-72(Feb 1973). (In German).

The radiation excited thermostimulated exoelectron emission of nine different LiF phosphors was investigated. The measurements were performed in high vacuum with a channel electron multiplier used as the detector. The exoemission glow diagrams were compared to the thermoluminescence glow diagrams. The investigations were carried out to check the possibilities of the application of thermostimulated LiF exoelectron emission in ionizing radiation dosimetry. (auth)

2745 RADIOACTIVE CALORIMETRY: A REVIEW OF THE WORK AT THE NATIONAL BUREAU OF STANDARDS. Mann, W. B. (National Bureau of Standards, Washington, DC). Nucl. Instrum. Methods; 112: No. 1-2, 273-277(1973).

Calorimetric measurements in the field of radioactivity are reviewed with special reference to the standardization of ^{63}Ni. Intercomparative measurements with the National Research Council of Canada and Atomic Energy of Canada Limited are discussed. (auth)

2746 RECENT DEVELOPMENTS IN CALORIMETRIC MEASUREMENTS OF RADIOACTIVITY. Ramthun, H. (Physikalisch Technische Bundesanstalt, Brunswick). Nucl. Instrum. Methods; 112: No. 1-2, 265-272(1973).

In this brief survey, several examples for radiometric calorimetry are given. The topics covered are the determination of activities, half-lives, decay energies, radiation doses, γ-ray intensities and burnup of nuclear fuels. One section deals with the classification of calorimeters and differences in application. (auth)

2747 RADIATION-PHYSICAL CHARACTERISTICS OF A NEW MEDICAL DOSIMETER, DBM-I. Bazhanov, E. B.; Dimov, V. I.; Kozlov, A. P. (Inst. of Oncology, Moscow). Med. Radiol.; 18: No. 11, 71-76(Nov 1973). (In Russian).

Some characteristics of detectors of bremsstrahlung and electron radiation of a DBM-I dosimeter which was used for the registration of absorbed doses on a new serial B5M-25 betatron are presented. The dependence of sensitivity of gallium-arsenide detectors upon the maximal energy of bremsstrahlung radiation spectra, rate of the absorbed dose and the temperature of the detector is defined. An assessment of the stability of operation of the dosimeter was made. (auth)

2748 DOSIMETRIC SYSTEM OF MEDICAL BETATRON OF B5M-25 TYPE. Tabarovskii, I. K.; Mandel'tsvaig, Yu. B.; Epishev, V. G. (Inst. of Medical Instrument Manufacturing in the Ministry of Medical Industry, Moscow). Med. Radiol.; 18: No. 11, 66-71(Nov 1973). (In Russian).

Demands for the dosimetric system of a medical betatron are described. Such an industrial system elaborated for a medical betatron of the B5M-25 type is described. The system consists of detectors of 3 types and a measuring unit. The detectors of bremsstrahlung radiation are the DTI-1 type which consists of two semiconductor GaAs-photo-transformers with series connection between which the plate of a CsI (Tl) scintillator is placed; the DTI-2 type consisting only of two GaAs-phototransformers. The detector of electronic emission is a thin-walled ionizing chamber of a through type. The measuring type is based on analog-frequency transformation of the signals and includes a dose-rate meter, dose dispenser and other units. (auth)

2749 POSSIBILITIES OF DIMINUTION OF A DETECTOR VOLUME IN CHEMICAL DOSIMETRY. Kalmykov, L. Z. (Kharkov Scientific-Research Inst. of Medical Radiology). Med. Radiol.; 18: No. 11, 62-66(Nov 1973). (In Russian).

When using the chemical method of dosimetry, it is possible to decrease the volume of a detector by employing microditches for making measurements of optical density, by dilution of the irradiated dosimetric solution before the analysis, or by the combination of these methods. The design of a special microditch with the solution volume of 1.4 ml and thickness of the layer of 30 mm to be used with a photoelectrocolorimeter is described. (auth)

2750 HANFORD THERMOLUMINESCENT MULTIPURPOSE DOSIMETER. Kocher, L. F.; Nichols, L. L.; Endres, G. W. R.; Shipler, D. B.; Haverfield, A. J. (Battelle Pacific Northwest Labs., Richland, WA). Health Phys.; 25: No. 6, 567-573(Dec 1973).

A five-element thermoluminescent dosimeter for beta particles, photons and neutrons has been developed using LiF blocks. One ^{7}LiF block is shielded to provide interpretation of the 1 cm tissue depth dose. A second ^{7}LiF block is unshielded to provide the derma dose interpretation. Two ^{6}LiF and one ^{7}LiF blocks are used for fast and thermal neutron dose interpretation. The accurate response of the dosimeter to the wide variety of radiation sources at Hanford makes it a good replacement for the Hanford film badge for routine personnel dosimetry. (auth)

2751 PRELIMINARY EVALUATION OF CaSO$_4$:Dy THERMOLUMINESCENT DOSIMETERS. McDougall, R. S.; Axt, J. C. (Univ. of California, San Francisco). Health Phys.; 25: No. 6, 612-613(Dec 1973).

There are at present several TLD materials being used in routine dosimetry measurements, each type having its own definite advantages and disadvantages. The one drawback originally with

$CaSO_4$: Mn was its fast fading characteristics; this has now been remedied by a newer improved type called $CaSO_4$: Dy. The fading pattern of this material is very similar to LiF. Several evaluations were carried out to determine if $CaSO_4$: Dy could be used in day-to-day dosimetry measurements and in particular for measuring low doses. It was found that with the replacing of manganese with dysprosium, $CaSO_4$: Dy can be of great use in making accurate dosimetry measurements, especially in diagnostic and health physics. (UK)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 2455, 3139, 3682, 4045, and 4368.

2752 (BIPM-72/6) MAXIMUM-LIKELIHOOD FIT TO POINTS ORIGINATING FROM DIFFERENT POISSON DISTRIBUTIONS. Gorman, D. J.; Mueller, J. W. (Bureau International des Poids et Mesures, 92-Sevres (France)). 1972. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

In the determination of absolute alpha-particle energies in a magnetic spectrograph, the energy is obtained by extrapolating the high energy edge of the alpha line to zero intensity. The method consists of fitting to the experimental points, a theoretical intensity distribution I(x) proportional to $(x-a)^N$ where x is the position on the photographic plate and a is the intercept. Using appropriate weights, a straight line of the form $x = a + b\,(I(x) - I_0)^N$ is currently fitted by the least-squares method. The total number of measured tracks I(x) follows a Poisson distribution and the least-squares method is unable to treat this case of asymmetric errors, therefore, a procedure was adopted based on the principle of maximum-likelihood. (FR)

2753 (INIS-mf-330) NEW VERSION OF A SECTORIAL MAGNETIC SPECTROMETER FOR THE STUDY OF INTERNAL CONVERSION ELECTRONS IN CAPTURE REACTIONS. Suarez, A. A. (Universidade Estadual de Campinas (Brazil)). Aug 1970. 97p. (In Portuguese). INIS.

Thesis.

The study, design, and construction of a β spectrometer is described. The spectrometer combines two magnetic sectors in a highly dispersive arrangement which deflects the neutron beam on a 95° angle into an orbit with a 50 cm average radius. The measurement of 0.02 to 10 MeV electrons with resolutions lower than 0.07% can be accomplished. (INIS)

2754 (INIS-mf-509) STUDY OF HARMONIC REFLECTIONS IN NEUTRON MONOCHROMATOR CRYSTALS. Fulfaro, R. (Universidade Estadual de Campinas (Brazil)). 1970. 117p. (In Portuguese). INIS.

Thesis.

A study of the higher order reflections in neutron crystal monochromators was made in order to obtain, for the IEA single crystal spectrometer, the operation range of 1.0 eV to 0.01 eV. Two crystals were studied, an Al(111) near 0.0 eV and a Ge(111) in lower energies. For the Ge(111) case the higher order contaminations in the reflected beam were determined using as standard the gold total neutron cross section and performing the crystal reflectivity calculation for several orders of reflection. The knowledge of the contamination for each order as a function of neutron wavelength allows the optimization of the filter thickness in order to avoid higher order neutrons. The Ge(111) crystal was used because its second order reflections are theoretically forbidden, giving an advantage on other crystals, since measurements can be made until 0.02 eV directly without filters. In the energy range 0.02 to 0.01 eV, order contaminations higher than the second are present; therefore, either quartz filters are employed or calculated corrections are applied to the experimental data. The Al(111) crystal was used in order to estimate the second order contamination effect in the iridium resonance measurements at $E_0 = 0.654$ eV. In that region approximations can be made and it was not necessary to make the crystal reflectivity calculation for the filter thickness optimization. Since only the second order affects the results in that region, tellurium was used for the filtration, because this element has a resonance in the range of neutrons with energy 4E. (INIS)

2755 (JINR-D6-7094, pp 167-169) IRON-FREE BETA SPECTROMETER WITH TOROIDAL MAGNETIC FIELD. Gasior, M. (Joint Inst. for Nuclear Research, Dubna, USSR); Gromov, K. Ya.; Kuznetsov, V. V.; Lizurei, G. I.; Potempa, A. V.; Dets, E.; Koretski, E.; Stakhevski, E.; Yanitski, M. 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

2756 (JINR-D6-7094, pp 170-171) TIMING WITH Ge(Li) DETECTORS INCLUDING PULSE SHAPE SELECTION. Manfrass, P.; Andrejtscheff, W.; Schilling, K. D.; Seidel, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

2757 (JINR-D6-7094, p 172) PROGRAM FOR THE PROCESSING OF COMPLEX PARTS OF SPECTRA WITH AUTOMATIC SETTING OF THE INITIAL APPROXIMATIONS. Avramov, S. R. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

2758 (JINR-D6-7094, pp 173-174) CALCULATION OF THE ERRORS IN THE DETERMINATION OF THE POSITIONS OF PEAKS EXPECTED DURING PROCESSING BY THE LEAST-SQUARES METHOD. Avramov, S. R.; Penev, I. P. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

2759 (JINR-D6-7094, p 175) PROGRAM FOR PROCESSING SPECTRA IN FORTRAN. Avramov, S. R. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

2760 (JINR-D6-7094, pp 176-177) FORTRAN PROGRAM FOR ANALYSIS OF COMPLEX PARTS OF A SPECTRUM. Avramov, S. R. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

2761 (JINR-D6-7094, pp 178-179) PROGRAM PROVISION FOR THE PROCESSING OF SPECTROMETRIC INFORMATION IN THE MINSK-2-BESM-6 COMPUTER SYSTEM. Avramov, S. R.; Zaikin, N. S.; Fominykh, M. I.; Tsupko-Sitnikov, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

2762 (USNDC-7, pp 88-90) MEASUREMENT OF GAMMA RAY PRODUCTION CROSS SECTIONS FOR CARBON AND NITROGEN. Hoot, C. G.; Orphan, V. J.; Verbinski, V. V. (Intercom Radiation Tech., San Diego, CA). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

2763 AUTOMATIC ANALYSIS OF GAMMA-RAY SPECTRA. Slavic, L. A. (Boris Kidrich Inst. of Nuclear Sciences, Belgrade). Nucl. Instrum. Methods; 112: No. 1-2, 253-260(1973).

A method for automatic analysis of γ-ray spectra is described. It includes two methods for original peak finding, which can be used alternatively or complementarily. The first is the IF-function method, where peaks are localized by the simple comparison of successive experimental data. The other is so called Gaussian product function method, where the peak finding is provided by the analysis of the function deduced in a simple way from four close experimental data points. A numerical method for the extraction of the extremely small peaks, where the actual experimental data are squared, is also proposed. (auth)

2764 CALIBRATION OF γ-SPECTROMETERS. Legrand, J. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Instrum. Methods; 112: No. 1-2, 229-238(1973).

The various aspects of γ-spectrometer calibration are examined. Two methods are described, one using the whole γ-spectrum and the other suitably chosen peaks. The problem of the choice of references is broached: multiple or single? Instrumental errors are studied, together with various corrections related to disintegration schemes. Finally the accuracy obtainable is discussed and it is shown that, for many radionuclides, γ-spectrometry is a precise and often the only possible method of measurement. (70 references) (auth)

2765 OPTIMAL SAMPLE ARRANGEMENT RELATIVE TO A DETECTOR. Silant'ev, A. N.; Shkuratova, I. G. At. Energ. (USSR); 34: No. 6, 477(Jun 1973). (In Russian).

Optimum arrangement of a counting sample with respect to the detector is important in the gamma spectroscopic analysis of samples having a low specific activity. Calculated optimum values of the radius of the counting sample, and values of the product of the solid angle multiplied by the self-absorption coefficient are presented for different sample volumes. The sample may be placed under an end-window counter, or around the counter. All values are given in counter radius units. The distance between the end-window crystal and sample is assumed to be 0.15 radius units. The distance between the crystal side and sample is 0.25 radius units. An experimental estimate of the optimal sample size agrees well with calculated values. A comparison of calculated and experimental counting efficiencies for gamma shows that the contribution of edge effects for samples surrounding the counter does not depend on the sample volume. Hence the photoefficiency for counting gamma rays on a sample surrounding the counter does not depend on the sample volume. For counting on an end-window counter with no self-adsorption the optimum sample radii are 0.50, 0.68, 0.85 and 1.11 for sample volumes of 0.5, 1, 2 and 5 respectively. The effective solid angles are 0.24, 0.22, 0.20 and 0.14 respectively. With a self-adsorption of $\mu = 0.3$, the optimal sample radii are 0.53, 0.69, 0.87 and 1.14 for these samples (the solid angles are 0.21, 0.19, 0.16 and 0.11 respectively). With the sample placed around the detector and zero self-adsorption the optimal sample radii are 1.45, 1.65, 1.95 and 2.54 for sample volumes of 5, 10, 20 and 50 (solid angles are 0.20, 0.18, 0.14 and 0.10). With a self-adsorption of $\mu = 0.3$, the optimal sample radii are 1.45, 1.65, 1.95 and 2.54 for these samples (the solid angles are 0.17, 0.14, 0.11 and 0.07). (SJR)

2766 GATHINA NEUTRON SPECTROMETER LOCATED AT THE PTI SYNCHROCYCLOTRON. Abrosimov, N. K.; Borukhovich, G. Z.; Kaminker, D. M.; Kudikov, A. V.; Mikheev, G. F.; Petrov, G. A.; Chernov, N. N. (Ioffe Inst. of Physics and Tech., Leningrad). pp 188-193 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From All-Union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The project parameters of the Gathina time-of-flight neutron spectrometer at the 1-GeV synchrocyclotron are reported. The total neutron intensity of the pulsed neutron source will be about 10^{14} n/s. The neutron pulse time width will be approximately 20 ns. This neutron source will be used for fission physics experiments and for studying (n,γ) reactions. (2 figures, 2 tables) (auth)

2767 NEUTRON DETECTOR FOR SPECTROMETRIC RESEARCH. Doil'nitsyn, E. Ya.; Stupak, A. I. (Physical-Power Inst., Moscow). pp 284-289 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From All-Union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

A neutron detector for use in time-of-flight experiments is described. The detector represents a mixture of polyethylene powder and Eu, Sm, Er, Hf. Neutrons are moderated and captured in Eu, Sm, Er, Hf to produce γ rays detected in NaI scintillation counters. The counters are connected in coincidence. (1 figure, 1 table) (auth)

2768 APPARATUS FOR THE STUDY OF THE (n,α) REACTION. Popov, Yu. P.; Rodionov, K. G.; Rumi, R. F.; Semenov, V. G.; Stempin'ski, M.; Florek, M. (Joint Inst. for Nuclear Research, Dubna USSR). pp 165-169 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From All-Union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The peculiarities of the detection and spectrometry of α particles in powerful neutron beams from pulsed sources are considered. The principal characteristics of the α-particle detectors of the type gaseous scintillation detector with an electric field and multiplate ionization chamber with a central collector are considered. A more detailed description of the multisection proportional chamber is given, as well as α spectrometers based on the multiplate ionization chamber and the ionization chamber with the target inclined towards the neutron beam at an angle of 15°. (1 figure, 1 table) (auth)

2769 EFFICIENCY OF COLLECTING AND RECORDING ELECTRONS IN A BETA-SPECTROMETER HAVING A Si(Li)-DETECTOR AND A SUPERCONDUCTING SOLENOID. Morozov, V. I. (Inst. of Nuclear Physics, Alma-Ata, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 703-705(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 42-44(1973).

For a β-spectrometer with a Si(Li)-detector and a superconducting solenoid the efficiency with which electrons are collected is calculated as a function of electron energy, field intensity, and the geometric parameters of the installation. It is shown that if the distance between the source and the detector is substantially greater than the maximum Larmor radius of the electrons in the magnetic field of the solenoid, then the efficiency of collection is equal to the ratio between the radius of the entry window and the diameter of the maximum Larmor orbit with good accuracy. The function describing the angular distribution of the electrons collected by the magnetic field on the detector is determined. (auth)

2770 SPECTROMETER WITH A Ge(Li)-DETECTOR FOR LOW-ENERGY GAMMA-QUANTA. Bylov, Ts.; Egoshin, I. N.; Ormandzhiev, S.; Osipenko, B. P.; Srnka, D.; Yurkovski, Ya. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 706-707(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 45-46(1973).

A spectrometer with a Ge(Li)-detector is described. A resolution of 650 eV was obtained for $E_\gamma = 26.35$ keV (^{241}Am) and 1.7 keV for $E_\gamma = 1332$ keV (^{60}Co). (auth)

2771 ELECTROSTATIC PRISMATIC BETA-SPECTROMETER WITH AXISYMMETRIC LENSES. Bobykin, B. V.; Kel'man, V. M.; Lyubov, S. K.; Nevinnyi, Yu. A. (Inst. of Nuclear Physics, Alma-Ata, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 700-702(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 38-41(1973).

The instrument is used to investigate radiative electron emission from radioactive substances. The instrument energy half-width of the lines is 0.08%. (auth)

2772 USE OF SURFACE-BARRIER Si(Li)-DETECTORS FOR THE SPECTROMETRY OF ELECTRONS. Il'in, A. A.; Selyutin, V. P.; Tutov, E. P.; Fedoseeva, O. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 752-754(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 83-85(1973).

The possibility was investigated of using batch-manufactured DKD-Ps detectors for the spectrometry of internal conversion electrons of ^{137}Cs for cooling down to a temperature to −60°C. A comparison is made between the properties of the detectors during the recording of electrons and α particles, and likewise between their spectrometric characteristics and noise at room temperature and at −60°C. (auth)

2773 SURFACE-BARRIER SILICON DETECTORS HAVING A LARGE AREA. Wilhelm, I.; Gumnerova, L. I.; Kratsikova, I.; Li Ch'eng Song; Osipenko, B. P.; Prakhov, N. M. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 750-751(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 81-82(1973).

Silicon surface-barrier detectors with a working area of 5.0 to 8.5 cm^2 have been fabricated for the spectrometry of heavy charged particles. The detectors were cut out of material of the n-type that was cut up into plates along the ⟨111⟩ axis and had a resistivity and lifetime scatter within the limits of 25% at the working length. The energy resolution measured for the α particles of ^{238}Pu + ^{241}Am was at worst 80 keV at room temperature, while in the best case it was <60 keV. (auth)

High Energy Physics Instrumentation

Refer also to abstract 3181.

2774 (CERN-Trans-73-4) ADVANCES IN THE FIELD OF CHERENKOV COUNTERS. Denisov, S. P. (Gosudarstvennyi Komitet Po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). Jun 1973. Translated by B. Hodge from IFVE-SEF-71-47. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

Topics include fundamental properties of Vavilov-Cherenkov radiation, threshold counters, differential counters and multichannel Cherenkov detectors. (31 references) (WHK)

2775 (CONF-730531-9) PROGRESS IN FLASH-TUBE AND OTHER HODOSCOPE CHAMBERS. Conversi, M. (Rome Univ. (Italy). Istituto di Fisica). 25 May 1973. 46p. Dep. NTIS (U. S. Sales Only) $4.50.

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973).

The hodoscope chamber as a shower detector, ionization measurements, mechanism of flash-tube discharges, reduction of the long-lasting effects, control of the sensitive time, reduction and control of flash-tube recovery time, and plastic chambers are discussed. (40 references) (WHK)

2776 (CONF-730531-10) PLASTIC CHAMBERS. Internal Note 467. Conversi, M.; Federici, L.; Taccetti, Q. (Rome Univ. (Italy). Instituto di Fisica; Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 28 May 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973).

A new kind of electrically pulsed track chamber, composed of sensitive elements of plastic material in which a noble gas mixture flows, is described. Some general features are: ease of obtaining large sensitive volumes of any geometrical shape; very low cost of construction and operation; high efficiency in detecting multitrack events; possibility of recording the information either optically, and in particular by TV systems, or electrically, by means of simple probes which yield pulses that need no amplification. Two particular versions of plastic chambers are described. One of them, made of honeycomb structured polypropylene, is characterized by lack of dead space; minimum amount of low Z insensitive material; space resolution in the mm region; time resolution which can be adjusted from $\sim$0.1 to $\sim 10 \mu s$ per element by varying the rate of gas flow through the sensitive elements. At the preliminary stage of the investigation only recovery times $\geq \sim 50$ ms have been obtained. (auth)

2777 (EFI-ME-2(71)) RESULT OF INVESTIGATION OF THE WIDE GAP SPARK CHAMBER WITH THE PARTICLE TRACKS DRIFT COMPENSATION. Avakyan, K. M.; Aivazyan, R. B.; Krishchyan, V. M.; Matevosyan, E. M. (Akademiya nauk Armyanskoi SSR, Erevan. Institut Fiziki). 1971. 10p. (In Russian). INIS.

Results are given for the machine processing of particle tracks which are obtained in a wide-gap spark chamber while it is fed with high-voltage radiopulses. It was shown that at an oscillation pulse frequency of 6 to 8 Mc/s the drift of particle tracks was completely absent, and the average quadratic value of the pseudo-angle is a factor of two less than when feeding the chamber with unipolar pulses. (auth)

2778 (FRNC-R-26) SCRO-BRANCH: READ-OUT SYSTEM FOR A MULTIWIRE PROPORTIONAL COUNTER (STANDARD PSEUDO-CAMAC). Note CAMAC 16-00. Berst, J. D.; Chatelus, Y.; Metzger, G.; Schaub, G.; Schultz, G. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Lab. de Physique du Noyau et de Physique des Particules). Dec 1972. 20p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The multiwire proportional chamber read-out system described is intended for a Ξ hyperons $\rightarrow n + \pi$ experiment. The general principle adopted is presented. A hybrid-delay receiver amplifier unit of the line memory is associated with each wire. The touched wire thus produced a memorized logic signal if coincidence occurs with a fast strobe pulse from DISC. A description is given of the system which is intended for the extraction of information from (SCRO-BRANCH) memories. (FR)

2779 (FRNC-R-27) SCRO-BRANCH: AMPLIFIERS AND MEMORIES FOR MULTIWIRE PROPORTIONAL CHAMBERS. Note CAMAC 16-01. Schultz, G.; Chatelus, Y. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Lab. de Physique du Noyau et de Physique des Particules). Feb 1973. 28p. (In French). Dep. NTIS (U. S. Sales Only) $3.50.

Hybrid circuits have been developed enabling a signal from a proportional chamber to be amplified and memorized. In order to memorize only events fulfilling certain fast triggering criteria of an experiment, the amplifier and memory circuit are housed in the same casing, a monostable circuit delaying the pulse at the amplifier output before its memorization. The high level of parasitic noise (two streamer chambers) near to the proportional chambers add to the necessity of reducing the dead time and to the necessity of separating the amplifier from the memory circuits. In consequence a linking cable (twisted pair of wires) producing a delay of 188 ns (measured with a reflectometer) is introduced. In this way the electronic delays are compensated without the introduction of a dead time. (FR)

2780 (RL-73-97) COMPUTER BASED INSTRUMENTATION OF THE 1.5 m HYDROGEN BUBBLE CHAMBER. Gottfeldt, P.; Morrissey, M.; Seddon, W. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). 1973. 46p. Dep. NTIS (U. S. Sales Only) $4.50.

A computer now forms an integral part of the bubble chamber instrumentation. The transducing equipment, the computer peripherals and the software of the computer based instrumentation are described. The computer operating system is described in an appendix. The objective in building the computer based instrumentation has been to provide the operators with a system which keeps a continuous close check on chamber operation thus giving early warning of misoperation or fault conditions and providing useful diagnostic information. The computer system is capable of fast data taking, and chamber parameters which are linked to the working cycle such as valve openings, beam timing, etc., can easily be monitored on each cycle of operation. The cause of erratic bubble chamber performance is thus easier to detect. The varying operation conditions of the chamber demand a high degree of flexibility in the system and therefore the bubble chamber operators must take full responsibility for ensuring that the computer is set up to provide a maximum of useful information. For this purpose the operating system (MANAGER) has been devised which allows the operator to communicate with the computer using simple command strings. The computer does not at present perform any control of a "closed loop" nature. (UK)

2781 700-LITER BUBBLE CHAMBER WITH A FREON FILLER. Baranov, D. S.; Boginskii, A. I.; Danil'chenko, I. A.; Ermolaev, V. I.; Ivakhnenko, I. N.; Krupnov, V. A.; Kuznetsov, E. P.; Mikhailov, O. I.; Netyaga, N. A.; Samarin, M. A.; Snyatkov, V. I.; Chabrov, N. A. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 720-722(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 57-59(1973).

The SKAT-M 700-liter bubble chamber is described, which is filled with 13V1 freon bromide. The chamber is designed for systematic investigations and tests of individual sections of the "SKAT" chamber having a volume of 7.5 m^3 which has been equipped at the Institute of High-Energy Physics. (auth)

2782 POLYETHYLENE SPARK CHAMBERS FOR MEASURING THE POLARIZATION OF PROTONS. Anan'in, P. S.; Glavanakov, I. V.; Kryshkin, V. I.; Sterligov, A. G.; Stibunov, V. N.; Usov, Yu. P. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 723-725(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 59-61(1973).

An installation is described for measuring the polarization of protons in the energy range from 100 to 250 MeV. The installation consists of four spark chambers and a scintillation telescope. Each spark chamber has two aluminum electrodes and glass side walls. Polyethylene plates—analyzers—are placed between electrodes in the form of shelves. The chambers are supplied from two generators that produce short pulses and are designed according to the Arkad'ev-Marc circuit. The voltage pulse appearing across the chambers has an amplitude of 250 kV and a leading-edge duration of 10 nsec. (auth)

2783 HODOSCOPIC INSTALLATION FOR INVESTIGATING THE ELASTIC SCATTERING OF HIGH-ENERGY PARTICLES. Borisov, A. A.; Bugorskii, A. P.; Bushnin, Yu. B.; Derevshchikov, A. A.; Dunaitsev, A. F.; Zhil'chenkov, V. D.; Matulenko, Yu. A.; Meshchanin, A. P.; Michailov, Yu. V.; Nurushev, S. B.; Sen'ko, V. A.; Smirnov, V. V.; Smirnov, E. V.; Siksin, V. V.; Solov'ev, L. V.; Solov'yanov, V. L. (Inst. of High Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 711-715(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 49-53(1973).

A scintillation hodoscopic installation for investigating the elastic scattering of particles having a momentum of 30 to 60 GeV/c is described. The range of scattering angles covered is 0 to 29 mrad with an angular resolution of ±0.17 mrad. The total solid angle is 39 μsr. The accuracy with which the momentum is determined is ±0.22%. The resolving time is 35 nsec. The dead time is 50 μsec. The momentum passband of the spectrometer is 8%. The rate of accumulating statistics is up to 10^6 in 1 hour. The installation is electrically coupled to a "Minsk-22" electronic computer that performs the storage and handling of information during the experiment. The results obtained are immediately delivered in the form of tables and graphs, as well as to the screen of an oscilloscope. Monitoring equipment is available which tracks the working order of the hodoscopes. The first results of the scattering of π^--mesons by nuclei at a momentum of 50 GeV/c and by protons in the interval of initial momenta from 30 to 50 GeV/c were obtained. (auth)

2784 TRACK SPARK CHAMBERS MADE OF FOAM POLYURETHANE. Bittibaev, S. M.; Kozhanov, E. V.; Nurgozhin, N. N.; Nurzhakipov, T. N. (Inst. of High-Energy Physics, Alma-Ata, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 726-729(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 62-65(1973).

Two versions of a three-electrode track spark chamber fabricated from PPU-305 foam polyurethane and metallized polyethyleneterephthalate (lavsan) film with an interelectrode gap of 2 × 175 mm and working-section dimensions of 850 × 850 mm were tested. The electrodes of the first chamber were wire, while the electrodes of the second were fabricated from lavsan film 100 μ thick which was metallized on both sides with a layer 0.1 μ thick. Without the gas purification system both chambers are operational for a day after filling. The service life of the chamber with the electrodes made of metallized lavsan is limited due to the damage to the metal coating caused by the action of the spark discharge. (auth)

2785 DISCHARGE-DIFFUSION CHAMBER. Dzhavrishvili, A. K.; Mandzhavidze, Z. Sh.; Roinishvili, V. N.; Grigashvili, N. S. (Inst. of Physics, Tbilisi, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 730-731(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 65-66(1973).

A new elementary-particle detector is described—a discharge-diffusion chamber; one of the first photographs of the track of a cosmic-radiation particle in a chamber having an argon filler is shown. (auth)

2786 EQUIPMENT FOR CONTROLLING AND MONITORING RFK-5 STREAK CAMERAS. Volodin, V. D.; Glagoleva, N. S.;

Matyushin, A. T.; Matyushin, V. T. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 732-735(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 66-69(1973).

Equipment for control and monitoring is described which is designed for the connection of 1 to 6 RFK-5 streak cameras. Principal attention is devoted to the circuit for automatic monitoring of the film transport and synchronous operation of several cameras. The installation is implemented using cells of the standard rack of the JINR for the electronic equipment. One installation has been operating for two years with wide gap spark chambers and another on the bench of a two-meter streamer chamber. (auth)

Radiometric Instruments

2787 (INIS-mf-165/3) PRINCIPLES OF CONTINUOUS RADIOMETRIC SORTING OF URANIUM ORES. Hejtman, J. (Vyvojovy Zavod Uranoveho Prumyslu, Kamenna (Czechoslovakia)). 1970. 16p. (In Czech.). INIS.

The basic theory of continuous sorting of uranium ores is derived. The effect on the total efficiency of the following parameters is discussed: the ore grain velocity, the measurement geometry and shielding, and application of lump cycle relations. The feasibility of applying the derived relations in technical optimization of sorting, measuring, and control devices is shown. (INIS)

2788 (INIS-mf-165/4) RADIOMETRIC SORTING OF URANIUM ORES IN MOVING TUBS. Adamec, V.; Muzikar, V. (Vyvojovy Zavod Uranoveho Prumyslu, Kamenna (Czechoslovakia)). 1970. 21p. (In Czech). INIS.

On the basis of a theoretical analysis (measurement error evaluation and system arrangement) and of model measurements, rules were established for a new arrangement of the measurement system. The advantages of the new arrangement are an increased efficiency of the measurements, an improved sensitivity and a reduced total measurement error, and a simple control of the performance of the scintillation apparatus. The output and the character of the measured values (digital measurement with background reversion) are suitable for computer processing. Various types of measurement devices and their arrangement are proposed. (auth)

2789 (ITJ-41) MEASUREMENTS OF THE THERMAL NEUTRON MEAN LIFETIME OF ROCK FORMATIONS BY MEANS OF A BOREHOLE NEUTRON GENERATOR. Chrusciel, E.; Massalski, J. M.; Morstin, K.; Starzec, A. (Akademia Gorniczo-Hutnicza, Krakow (Poland). Instytut Techniki Jadrowej). Apr 1973. 50p. Dep. NTIS (U. S. Sales Only) $4.50.

The present state of a pulsed neutron logging technique in Poland is described. The problems connected with the proper determination of the neutron lifetime of rock formations and concerned geological quantitative interpretation are discussed. The interfering influence of background radiation in measurements with gamma-ray detection was eliminated by introducing the three-gate symmetrical detection system. Some pulsed neutron measurements, performed with the use of three-gate detection in cased holes, are described. For intervals of relatively uniform lithology, the results obtained correlate with the indications of standard open-hole logging methods. Conclusions concerning the further development of pulsed neutron techniques in well-logging are discussed. (auth)

2790 NUCLEONIC CONVEYOR WEIGHING. Cameron, J. F. (Nuclear Enterprises Ltd., Reading, Eng.). Phys. Bull. (London); 24: 605-606(Oct 1973).

The advantages obtainable from a continuous conveyor weigher system are outlined and especially those from the nucleonic weigher (the Neweigher) which has no moving parts and provides a noncontact measurement which results in minimum maintenance and long life within specification. It is easy to mount on any conveyor at any angle, and requires no modification to the conveyor and very little space. Calibration can be checked in a few minutes without stopping the conveyor and requires only a short run on an empty conveyor with and without a metal calibration plate inserted in the radiation beam. The equipment consists of a measuring head which is mounted on the conveyor, and indicator/control unit sited in a position convenient to the operators either in the vicinity of the measuring head or in a control room, and a tachometer to measure the conveyor velocity. The measuring head contains the source (^{137}Cs or ^{60}Co) and detector rigidly mounted above and below the conveyor respectively on a robust steel framework, and a head electronics unit. In the electronic indicator/control unit the signals from the measuring head and the tachometer are processed to indicate mass flow rate and total mass conveyed since the instrument was last reset. Source, detector and measuring head geometry are selected according to the following criteria: good precision and accuracy, compactness, low radiation dose rates and low cost. The precision of the Neweigher is a function of conveyor loading, source activity and integrating time of the electronics, and is generally about 1% of the mass flow rate and 0.5% of the total load. Accuracy is sometimes as good as the precision but depends on the quality of the calibration and the degree of variation of the factors contributing to changes in calibration including profile, composition and particle size. (UK)

2791 ARGON MICRODETECTOR AND TRIODE ARGON DETECTOR WITH ^{63}Ni IONIZATION SOURCES. Lasa, J.; Bros, E. (Inst. of Nuclear Physics, Krakow). Chem. Anal. (Warsaw); 18: No. 4, 825-828(1973). (In Polish).

The results of an investigation of micro-argon and triode argon detectors are presented. ^{63}Ni is used as the ionization source in both detectors. The results concerning the effect of the mutual position of the detector electrodes on the voltage-current characteristics and on the limit of detectivity are given. The minimum detectable quantity is 10^{-12} g/s for both detectors for benzene and n-pentane. (auth)

2792 SOME QUESTIONS OF MOISTURE DETERMINATION BY NEUTRON REFLECTION METHOD. Csom, G. (Technical Univ., Budapest); Benedek, S. Isotopenpraxis; 9: No. 8, 284-287 (Aug 1973).

Some problems of moisture determination based on neutron moderation and reflection are examined such as moisture determination in thin and variable layer thickness, increase of sensitivity to moisture variation and reduction of measurement error due to variations in the material composition. A new arrangement to meet these requirements is suggested. (auth)

2793 WHAT THEY LEARNED ABOUT ON-LINE USE OF A NUCLEAR MOISTURE ANALYZER. Eskes, J. M. (Canadian Bechtel Ltd., Montreal). Can. Contr. Instrum.; 11: No. 10, 30-32(Oct 1972).

A brief description of on-line moisture measurement is presented. The technique reported utilizes a nuclear moisture gage to monitor materials transported by several conveyor systems. Conditions for optimum use of the nuclear moisture gage are established. Performance of the nuclear gage is compared with that of laboratory methods. (CA)

2794 DETERMINATION OF THE MEAN SIZE OF SOLID PARTICLES CONTAINED IN A FLUID BY SCATTERING OF X-RADIATION. Carr-Brion, K. G.; Bramwell, S. E. (to National Research Development Corp.). US Patent 3,749,910. 31 Jul 1973. Filed Date 28 Sep 1970. 6p.

When electromagnetic radiation is passed through a heterogeneous material such as a slurry or suspension, part of the radiation will be scattered by the suspending medium and part by the solid particles contained in said medium. If, for example, the radiation used is x radiation, and if the suspending medium consists of a relatively low atomic number material while the particles consist of a relatively high atomic number material, then due to the fundamental properties of scattered x rays the bulk of the Compton or modified scattered x rays will come from the suspending medium, and the Rayleigh or unmodified scattering will come both from the particles and the suspending medium. If the x-ray energy is suitable, the Rayleigh scattering will be independent of the size of the particles, but the Compton scattering will be markedly dependent on the size of the particles. Comparison of the Compton scattering or of the Rayleigh and Compton scattering provides a measure of the size of the solid particles. The apparatus is described. (Official Gazette)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstract 3138.

2795 (LYCEN-7322) PHOTOCURRENTS INDUCED BY A RADIATION IMPULSE IN SEMICONDUCTOR DEVICES. Gaillard, R. (Lyon Univ. (France)). 1973. 85p. (In French). Dep. NTIS (U. S. Sales Only) $6.25.

Thesis.

The fundamental mechanisms involved in the transient effects induced in semiconductors by radiation were studied in view of hardening of electronic systems. The following techniques for electrically testing and stimulating transient effects are described: neodymium switched lasers, GaAs diode lasers, proton pulses from pulsed Van de Graaff machines, electron pulses from a Bevatron, and pulses from gamma-ray generators. The primary photocurrent from the base-collector junction is an important parameter. Calculation methods were developed for low levels of generation (small dose rates). The application of relations obtained for the primary photocurrents to calculations of the overall response of bipolar transistors (secondary photocurrents, storage time when exposed to radiations) is envisaged, the way in which the photocurrents can be included in the large signal models used in the CAO programs for analyzing the circuits being described. For the case corresponding to a high level of generations, a complete analysis of the phenomena is given. In particular, two structures are studied: a thin N^+NP^+ epitaxial junction and a P^+N junction. The problem of anomalous photocurrents in epitaxial devices was also studied. (FR)

2796 (SLA-73-702) THEORETICAL STUDY OF THE EFFECTS OF IONIZING RADIATION ON DIFFUSED RESISTORS. Fossum, J. G. (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1973. Contract AT(29-1)-789. 59p. Dep. NTIS $5.00.

A theoretical study of diffused resistors in an ionizing radiation environment is described. The two basic effects—conductivity modulation, which is generally insignificant or can easily be rendered so, and photocurrent generation, the consequences of which essentially determine the diffused resistor hardness—are examined. Typical diffused resistors are shown to be quite invulnerable to ionizing radiation, and the feasibility of using them in hardened integrated circuits is implied theoretically. Designed guidelines to achieve optimum hardness are enumerated. (auth)

Miscellaneous Instruments

Refer also to abstracts 3294 and 3883.

2797 (CEA-CONF-2348) AUTOMATION OF MEASUREMENTS CONCERNING METASTABLE PARTICLES USING A SMALL COMPUTER. Ahrweiller, M.; Fajoles, M.; Felix, J. P.; Hourdin, A.; Jeudon, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 22 Dec 1972. 8p. (In French). (CONF-730459-3). Dep. NTIS (U. S. Sales Only) $3.00.

From international exhibition and congress mesucora 73 and 64 physics exhibition meeting; Paris, France (11 Apr 1973).

The use of a small computer to automate measurements in two experiments concerning the physics of metastable particles (Penning and associative ionization; the scattering of fast metastable particles) is discussed. In the first experiment, which involves collisions between a beam of metastable helium and neutral inert gas particles, the effective ionization cross section was measured using a mass spectrometer and the electron spectrum was also determined. The computer is used in conjunction with weighted time-of-flight measurements and enables a reliable, multichannel and entirely electronic system to be employed. In the second experiment, collisions involving the inelastic exchange of an electron between a proton beam and a jet of neutral alkali atoms were studied. The fine structure observations necessitate a high angular resolution in view of the very small particle flux measured. The counting of the very low pulse arrival rates, which are partially obscured by background noise, requires a method in which parasites are eliminated. (FR)

2798 (EUR-4874) CONTRIBUTION TO THE STUDY OF THERMOCOUPLE DRIFTS. Physical Electronics of the Thermoelectrical Effect and Outline of an Elementary Theory of the Heterogeneous Thermocouple. Mathieu, F.; Meier, R. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Aug 1973. 133p. (In French). Dep. NTIS (U. S. Sales Only) $8.75. EUR FB 165,-.

With the aid of a model based on physical electronics it is shown that the measurable emf delivered by a thermocouple is entirely generated in the thermal gradient without any contribution coming from the hot junction. This holds also for drifts initially present or appearing with time. Starting from this fact, a simple experimental method is proposed that allows the problem of thermocouple drift estimation to be studied quantitatively. The heterogeneous wires are thermoelectrically explored by means of a laboratory furnace with a flat temperature profile, the temperature being increased successively to different values. The measured emfs called "error emfs" are error signals corresponding to specified experimental conditions. They allow the evaluation of the real drifts that a heterogeneous thermocouple will display when put into service in a given situation complying with some general criteria. The determination of error emfs and drifts generated by nuclear radiation is only a special case of the general method. A set of experimental results illustrates what can be the magnitude of the error emfs in several practical situations. Special attention is drawn to the following items: (a) drifts due to the diffusion of aggressive impurities through the stainless steel sheaths of the chromel-alumel thermocouple type currently used in nuclear applications. Illustrative results involving oxygen and graphite diffusion are related, and (b) a concept of a temperature memory based on the exposed principles. The necessity to define explicitly in an unambiguous way electrical polarities is emphasized in order to facilitate correct transmission of information between different experimenters. For the same purpose it is also suggested to standardize working methods. It is furthermore recommended to substitute for the thermodynamic model of the thermocouple an electrical model which seems to be less confusing for temperature measuring purposes. Very good reproducibility of thermoelectric characteristics is achievable under laboratory conditions. (auth)

2799 (EUR-5026) USE OF CAPACITANCE PROBES FOR TRANSIENT VOID-FRACTION MEASUREMENTS IN A TWO PHASE FLOW WATER-VAPOR. Herzberger, P.; Bonvini, C. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Sep 1973. 18p. (In German). Dep. NTIS (U. S. Sales Only) $3.00. EUR BF 40,-.

Capacitance probes for transient void-fraction measurements in a two-phase flow system (water-vapor) were studied. A capacitance bridge with a frequency of 1 kHz was used for the measurements. Different geometries of void were simulated. The tests showed an important dependence of the void geometry for constant void fraction. Thus the proposed method can be used only when the void distribution is known. (auth)

2800 (JINR-D6-7094, pp 180-181) MEASUREMENT OF THE CROSS SECTION FOR THE PHOTODISINTEGRATION OF NUCLEI BY THE ABSORPTION METHOD WITH USE OF AN ON-LINE COMPUTER. Gurevich, G. M.; Zapevalov, V. A.; Lavrova, I. S.; Lazareva, L. E.; Solodukhov, G. V.; Yavorovskii, V. I. (Inst. of Nuclear Research, Moscow). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

2801 (KFKI-73-33) DIGITAL/ANALOGUE PHASE CONTROLLER FOR dc SERVOMOTORS OF THE IBR PULSED REACTOR AT THE JINR, DUBNA. Kammel, W.; Kim Von Zu; Palmai, I. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

A simple and inexpensive digital/analog phase controller was designed for use with a dc servomotor driving an Al single crystal neutron beam chopper. After the automatic start-up the motor is phased by a logical circuit. The prescribed accuracy is ensured by a phase comparator. The phase stability is better than ±3.5 μsec (±0.15°) at 7500 rpm. (auth)

2802 (SGAE-2162) CAMAC–INTERRUPT–REGISTER. Schwabach, H.; Gratcl, P.; Attwenger, W. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Elektronikinstitut). Aug 1973. 16p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

12 input signals, in pairs And-connected and 18 other input signals are stored in a register. The contents of the storage register can be put on the dataway. The outputs of the storage register can be connected in an Or-circuit in order to generate a LAM-signal. A selective reset-circuit avoids the loss of LAM-signals even while clearing the storage register. (auth)

2803 GAUGE PROVIDING X-RAY EMISSION ANALYSIS THROUGH LOW ENERGY DETECTION WITH EXCITATION BY A RADIONUCLIDE RADIATION SOURCE. Robert, A. (CEN de Saclay, Gif-sur-Yvette, France). Isotopenpraxis; 9: No. 5, 153-159(May 1973). (In German).

The "SARIEL" roentgenfluorescence analyzer with radioisotope sources developed by the Nuclear Research Center of Saclay, France, is described. The gauge has a windowless proportional counter as detector. When use is made of α-radiation sources, it renders possible even determination of light elements such as carbon. The construction of the gauge is described, and some typical uses are explained. (auth)

2804 SEGMENT COLLIMATORS: A COMPARISON OF THEORETICAL AND EXPERIMENTAL RESULTS. Abraham, K. (Medizinische Akademie, Magdeburg, Ger.). Isotopenpraxis; 9: No. 1, 17-22(Jan 1973). (In German).

The results of the calculation and the testing of two focusing segment collimators made of tungsten powder metal were compared. It was found that the collimators have the desired characteristics. The results lead to the conclusion that the segment collimators designed according to the method of calculation with regard to the web penetration at increased energy shows closer conformity to the results of preliminary calculations, if $\mu\, w_{min} = 3$ for $P_S \leqq 0.05$. (auth)

2805 IMPROVEMENTS IN OR RELATING TO PYROMETERS. Smith, A. (to United Kingdom Atomic Energy Authority). British Patent 1,325,438. 1 Aug 1973. Filed date 20 Oct 1969. 4p.

Reference is made to pyrometers for measuring the temperature of objects located in remote and inaccessible regions, as for example in nuclear reactors. The pyrometer described comprises a temperature sensor having two temperature sensitive surfaces, with means for producing a differential signal representative of a difference in temperature of the two surfaces. An optical lens focuses thermal radiation from the object being measured onto the first temperature sensitive surface. A reference heat source is provided, with a second optical lens for focussing its thermal radiation onto the second temperature sensitive surface. The temperature of the reference source may be varied in response to the differential signal, so as to establish a null condition, with means for measuring the temperature of the reference source. Constructional details and mode of operation are given. The sensor, the optical lenses, and the reference heat source may be mounted in an enclosure, with the first lens mounted on a wall of the enclosure, and the second lens treated so as to divide the enclosure into two chambers, the interiors of which may, or may not, be interconnected. In the case of separate chambers at least one may be evacuated, or may contain a gas. The chamber in which the reference source is located preferably contains a gas having similar characteristics, for example thermal conductivity, to the environment between the first optical lens and the object. Apertured plates may be provided to cut off outer extremities of the beams of thermal radiation directed at the first and second lenses. The differential signal may be used to control the power supplied to an electrical resistance heater that provides the heat for the heat source, the temperature of the object being measured as a function of the power. (UK)

2806 SNEAK-CIRCUIT ANALYSIS. Rankin, J. P. (Boeing Co., Houston, TX). Nucl. Safety; 14: No. 5, 461-469(1973).

Beginning in late 1967, The Boeing Company in Houston, Tex., developed a computer-aided electrical-systems-analysis technique to help assure troublefree operation of NASA's Apollo and Skylab hardware. The technique, called "sneak-circuit analysis," is based on the discovery that there are topological criteria that enable prerecognition of a circuit to exhibit unplanned modes of operation. The results of sneak-circuit analysis over the last 5 years have shown that it is no longer necessary to accept the supposition that a few operational surprises are inevitable in complex electrical systems. Electrical systems can be made foolproof from the operational point of view; specifically, sneak-circuit analysis will disclose all latent current paths, inadvertent inhibits or activations, ambiguous system indications, and misleading console labels. Relay races, sneak grounds, and power-supply crossties are included. This article presents an overview of these problems and other products of the analysis as found in aerospace, commercial, and nuclear systems. (auth)

2807 NEUTRON CHOPPER WITH SYNCHRONOUSLY ROTATING ROTORS SUSPENDED IN A MAGNETIC FIELD. Kalebin, S. M. (Inst. of Theoretical and Experimental Physics, Moscow); Rukolaine, G. V.; Artamonov, V. S.; Nikol'skii, S. N.; Kocherygin, N. G.; Pelevin, G. A. pp 276-284 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From All-Union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

A neutron chopper with synchronized rotors suspended in a magnetic field is described. The chopper interrupts the neutron beam of the SM-2 reactor. The flight path is equal to 100 m. The rotational stability of the rotors was investigated, as a function of their principal moments of inertia. The electronic equipment for the synchronization of rotor rotation is described. The experimental data about the accuracy of synchronization of rotor rotation are given. (4 figures, 2 tables) (auth)

2808 SYSTEM OF FAST ELECTRONIC BLOCKS FOR PHYSICS EXPERIMENTS, BASED ON THE CAMAC STANDARD. Basiladze, S. G.; Gvozdev, V. Ya.; Kolpakov, I. F.; Man'yakov, P. K.; Tlachala, V. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 758-762(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 88-92(1973).

A system of fast electronic blocks in the High-Energy Laboratory of the Joint Institute of Nuclear Research is described. The system contains 7 logical blocks, 5 linear blocks, and 4 blocks for controlling and converting the signals. Its principal distinguishing features are: implementation based on the combined "CAMAC-Vishnya" standard; the introduction of electronic control of the parameters of the blocks; the logic of the operation of the output shapers has no missed counts during the length of an output pulse. (auth)

2809 AVALANCHE SEMICONDUCTOR NEGATRONS AND THEIR APPLICATION (REVIEW). D'yakonov, V. P. (Moscow Power Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 665-679(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 7-20(1973).

New types of avalanche transistor negatrons and their fields of application are described. The advantages of negatrons over known types of active devices are demonstrated in terms of speed of response, simplicity, and multifunctionality of the circuits, ease of controlling the shape and parameters of the volt-ampere characteristics, the possibility of realization in integrated implementation, etc. A large number of negatron circuits are presented. (93 references.) (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

2810 (CEA-CONF-2293) INTERNATIONAL CONTRACTS ON URANIUM ENRICHMENT. Darricau, A. (CEA Direction des Productions, 92-Chatillon (France)). 1973. 17p. (In French). (CONF-730341-3). Dep. NTIS (U. S. Sales Only) $3.00.

From international cooperation in reactor material and nuclear fuels conference; Paris, France (2 Mar 1973).

The privileged position of the US Atomic Energy Commission as the unique supplier gives these contracts a strong political character. The enrichment service determines both the price and conditions of sale. It is thus in the interest of the users to develop an alternative means of obtaining enriched uranium. (FR)

2811 (MLM-2092(TR)) DEPLETION COLUMN FOR THE COLLECTION OF PROTIUM OXIDE, $^{1}H_2O$, BY ISOTOPE EXCHANGE BETWEEN HYDROGEN AND WATER. Mercea, V.; Palibroda, N.; Fodor, T.; Stoicovici, L. Translated from Isotopenpraxis; 4: No. 8, 328-330(1968). 8p. Dep. NTIS $3.00.

A continuously operating depletion column was developed to produce deuterium-depleted water. This was required in large amounts for producing standard samples with deuterium concentrations below the natural isotope composition. A countercurrent separation column was selected which combined two elemental separation processes: (1) a catalyzed ion exchange between hydrogen and water vapor, and (2) a countercurrent distillation between water vapor and a water film. The major portion of the separation effect is attributable to isotope exchange, while distillation guarantees the countercurrent conditions. The lower end of the column is fed with hydrogen of natural isotope composition, whereas at the upper end, phase reversal is accomplished by combustion of the hydrogen. (TFD)

Isotopic Power Sources

2812 (ORNL-4205) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING SEPTEMBER 30, 1967. Lamb, E. (Oak Ridge National Lab., Tenn. (USA)). Nov 1967. Contract W-7405-eng-26. 26p. Dep. NTIS $3.50.

Declassified 29 Mar 1973.

Experiments were designed to determine the helium release from three types of $^{244}Cm_2O_3$ fuel forms. A program was initiated to determine the compatibility of $^{244}Cm_2O_3$ with Ta, Ta-10% W, T-111, Mo, TZM, W, and W-26% Re at temperatures of 1650 and 1850°C. Experiments were designed to obtain characteristics (i.e., creep strength, thermal conductivity) of potential containment materials in their operating environments. A thermionic capsule support system was conceptually designed. Studies were initiated to determine the applicability of the sol-gel process to the preparation of curium oxide spheres. The use of the modified thermal conductivity apparatus (3M Model TC-200) was successfully demonstrated using an electrically heated pellet to simulate ^{90}Sr fuel forms. A program was initiated to evaluate the compatibility of SrO, $SrTiO_3$, and Sr_2TiO_4 with Hastelloy C, Haynes 25, and Type 316 stainless steel. A 32,000-curie SrO source clad in platinum that had been exposed to a temperature of 780°C for 90 days was examined; the source was contained in an inner capsule of Hastelloy X and an outer capsule of Hastelloy C. A hot press for pressing 4-in.-dia $SrTiO_3$ pellets was designed. Examination of the effect of weld current variation on penetration for several joint designs and the optimum penetration which could be obtained with a given joint design while retaining one edge for ultrasonic testing purposes was begun. The oxidation resistance of capsule materials (Hastelloy C, Inconel 600, and platinum) in air at 2000°F and the corrosion resistance at 2000°F in clay-type soil common in the vicinity of ORNL were obtained for periods up to 6 and 7 months, respectively. Microspheres of $^{238}PuO_2$ with a density high enough to meet necessary requirements were prepared by the modified sol-gel process for the small-scale experimental program. The 24 pellets contained in the four capsules of the SNAP-7A generator were removed and inspected; 15 were completely intact, 7 were cracked, 1 was chipped, and 1 was broken into several pieces. There was no visible evidence of mechanical damage or chemical attack on the inside capsule surfaces or spacers. The proposed requirements of the SNAP-21 capsule weld acceptance criteria were prepared. A device for handling the loaded SNAP-23A capsule liner and placing the capsule in the welding chamber was designed. Aging conditions and results of Charpy impact tests at 600°F on Haynes 25 were obtained. (auth)

2813 (ORNL-4432) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING MARCH 31, 1969. Lamb, E. (Oak Ridge National Lab., Tenn. (USA)). Jul 1969. Contract W-7405-eng-26. 22p. Dep. NTIS $3.25.

Declassified 29 Mar 1973.

A Thermionic Engineering Mockup test was scheduled. The heat source matrix and the test capsule designs for this mockup were completed. A new method for measuring the heat capacity of self-heated radioactive materials was devised. The shipment of ^{244}Cm from Savannah River Laboratory was assayed calorimetrically; the values obtained are in good agreement with those reported by Savannah River. A transverse cracking problem developed during the production of welded TZM creep specimens. This "cold cracking" appears to be initiated by "hot cracking." Welding conditions have been optimized for the metals and alloys to be investigated in the low- and intermediate-temperature tests. Chemical analyses of the compatibility couples of Hastelloy C with nonradioactive $SrTiO_3$ containing 1% SiO_2 additive showed a pickup of oxygen at 1100°C. Experiments showed that the most likely impurity which could provide the oxygen is water. Studies were begun to determine the effect of the decay products on ^{90}Sr fuels. The creep rates of Haynes 25 specimens in vacuum at 900°C are ~40 times greater than those tested in air and their rupture lives are ~25 times lower. The third SNAP-21 generator was loaded and shipped to 3M Company. Preparations are being made to hydrostatically test the SNAP-23 capsules. (auth)

2814 (ORNL-4454) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING JUNE 30, 1969. Lamb, E. (Oak Ridge National Lab., Tenn. (USA)). Sep 1969. Contract W-7405-eng-26. 18p. Dep. NTIS $3.00.

Declassified 29 Mar 1973.

The Thermionic Engineering Mockup test was scheduled. The temperature distribution along the capsule vent tube has been calculated and the results used to perform aging studies of the welded joint between the tungsten vent tube and the stainless steel expansion coil that leads into the helium reservoir. Tests are in progress to evaluate the compatibility of Ni, Ni-10% Cr, Ni-20% Cr, Co-10% Cr, Hastelloy C, Hastelloy N, and Haynes alloy No. 25 with $^{244}Cm_2O_3$ at temperatures of interest for thermoelectric and Brayton-cycle applications. The temperature range of the thermal conductivity data on Cm_2O_3 has been extended from 536 to 1081°C. Silicon dioxide was added to SrO during its processing to ensure a hot-pressed pellet of high density. The role of silicon in capsule materials will be studied with respect to compatibility effects. The creep rates of Alloys S-5 (Fe_3Pt) and S-6 (CoPt) are being measured as a function of temperature and constant stress, and the effects of long-range order on the creep behavior of Co-Ni-V alloys are being determined. The fourth SNAP-21 source was loaded and shipped. (auth)

2815 (ORNL-4501) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING SEPTEMBER 30, 1969. Lamb, E. (Oak Ridge National Lab., Tenn. (USA)). Dec 1969. Contract W-7405-eng-26. 28p. Dep. NTIS $3.50.

Declassified 29 Mar 1973.

The Thermionic Engineering Mockup test was scheduled. The primary vacuum chamber is ~95% complete. The thermal expansion of the capsule and disk has been calculated at various temperatures to confirm that the disk can be inserted into the capsule. The measurement of the thermal conductivity of dense pellets of $^{244}Cm_2O_3$ has been completed. Fourteen values of the helium diffusion parameter of $^{244}Cm_2O_3$ at steady state have been obtained at temperatures from 600 to 1500°C. Two series of $^{244}Cm_2O_3$ compatibility-couple exposures were completed. Additions of SiO_2 to SrO did not reduce the extent of interaction between SrO and Haynes alloy No. 25 or Hastelloy C samples. The effects of long-range order on the creep behavior of Co-Ni-V alloys are being determined as a function of stress up to 30×10^3 psi. The fueling of the SNAP-23 generator was scheduled. (auth)

2816 RADIOISOTOPIC HEAT SOURCE. Sayell, E. H. (to United States Atomic Energy Commission). US Patent 3,767,930. 23 Oct 1973. Filed date 21 Jun 1972. 6p.

A radioisotopic heat source is described which includes a core of heat productive, radioisotopic material, an impact resistant layer of graphite surrounding said core, and a shell of iridium metal intermediate the core and the impact layer. The source may also include a compliant mat of iridium between the core and the iridium shell, as well as an outer covering of iridium metal about the entire heat source. (Official Gazette)

Radiation Sources

Refer also to abstract 3117.

2817 (CEA-CONF-2324) INDUSTRIAL APPLICATIONS OF IRRADIATION: INCREASE IN THE USA, DIVERSIFICATION IN JAPAN. Puig, J. R.; Laizier, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Centre d'Application et de Promotion des Rayonnements Ionisants). 10 Apr 1973. 6p. (In French). (Conf-730343-2). Dep. NTIS (U.S. Sales Only) $3.00.

From meeting on the development of industrial applications of radiation chemistry; Paris, France (13 Mar 1973).

In order to predict the European evolution of the applications of irradiation, the situation in the two countries currently leading in world radiochemical techniques, the United States and Japan, is presented. (FR)

2818 (CLOR-95/D) TRACK ETCH DETECTOR METHOD FOR LEAKAGE TESTING OF RADIUM SOURCES. Mamont-Ciesla, K.; Biernacka, M.; Wasilewski, A. (Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland)). 1973). 18p. (In Polish). Dep. NTIS (U. S. Sales Only) $3.00.

A review of routine methods for the quantitative evaluation of radium source leakage is given. The track etch detector method based on Bayer foil "Trifol TN" is discussed. This method for leakage testing of radium sources is the most sensitive one. For a volume of 40 cm^3 in which radon-222 is collected during an exposure of 24 hours, the minimum measured leakage is equal to the release of one atom of ^{222}Rn/s. The authors propose to accept the release of radon-222 equal to 100 atoms of ^{222}Rn/s as a threshold value of leakage above which the sealed source should be considered as a leaking one. (auth)

2819 STORAGE OF RADIOACTIVE SOLUTIONS WITH STANDARDIZED DISINTEGRATION RATES. Lowenthal, G. C.; Wyllie, H. A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nucl. Instrum. Methods; 112: No. 1-2, 367-371(1973).

The complex and time consuming work of standardizing the activity of radioactive solutions makes it desirable to preserve the integrity of these solutions as long as possible. This applies in particular when standards laboratories must frequently satisfy routine requirements for liquid and solid sources with accurately known disintegration rates. Activity measurements are then commonly made with secondary standard instruments. An alternative and often more flexible method of storage uses containers which allow easy access to the solutions for source making, while losses of solvent or of radioactivity remain very small and measurable with sufficient accuracy so that the errors in the original disintegration rate measurements are not unduly increased. Storage problems are discussed with special reference to the methods used in the Lucas Heights laboratory. (auth)

2820 PHYSICO-TECHNICAL FEATURES OF A CESIOTERAX 2 RADIOTHERAPEUTIC UNIT WITH A ^{137}Cs SOURCE OF RADIATION. Maslovaric-Jablonska, K.; Cisowska Pakula, B.; Studencki, E. (Osrodek Onkologiczny, Lodz, Poland). Pol. Przegl. Radiol. Med. Nukl.; 37: No. 4, 565-568(1973). (In Polish).

The structure of a ^{137}Cs Cesioterax 2 unit for telegammatherapy, its technical parameters, the design of the headpiece, and the conditions of radioprotection are described. The collimation of the radiation beam was determined in the light of measurements performed. (auth)

2821 GUIDELINES FOR MAINTAINING COBALT-60 AND CESIUM-137 TELETHERAPY EQUIPMENT. Rockville, MD; Bureau of Radiological Health (1973). 31p. (ANSI-N-44.2.7). American Society for Testing and Materials, New York.

A draft of a standard is presented which is proposed to establish guidelines for the inspection and maintenance of the mechanical, electrical, and radiation-defining components of ^{60}Co and ^{137}Cs teletherapy equipment. The objective of the standard is to define an effective inspection and maintenance program for teletherapy equipment which will lead to the radiation safety of operating personnel and delivery of accurate doses to patients. The standard specifically recommends initial acceptance tests and a schedule of periodic inspection and maintenance operations. The schedule of 21 periodic inspection and maintenance operations include, for example, head movement, electrical and mechanical source-condition indicator check, timer, source-surface distance (SSD), beam orientation, isocenter, facility door interlock and source leakage. Further specific guidance is given on the maintenance of teletherapy units with: rotating shutters, moving source drawer; moving shutter blocks; mercury shutter mechanism; and pneumatic activating systems. The appendix (which is not a part of the standard) provides information on the effects of radiation on lubricants used in teletherapy units. (auth)

2822 PLASMA FOCUS AS A PULSED SOURCE OF NEUTRONS FOR THE FUSION REACTION. Filippova, T. I.; Filippov, N. V. (Inst. of Atomic Energy, Moscow). pp 194-200 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From All-Union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

Physical principles of operation of the plasma focus device are described. The total number of neutrons per pulse, pulse duration, and repetition rate are presented. The neutron yield is given as a function of the energy storage of the device. The dependence obtained is extrapolated up to 10^5 J. (2 figures, 1 table) (auth)

Industrial Uses

Refer also to abstracts 2856 and 2857.

2823 (EURISOTOP-73) POSSIBILITY OF THE IMPROVEMENT OF FIREPROOFING EQUIPMENT FOR TEXTILES. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). 1972. 93p. (In French and German). Dep. NTIS (U. S. Sales Only) $6.75.

Fifteen papers on the technical and economic aspects of improving industrial facilities for flameproofing textiles for furnishings and clothing were presented, and were grouped in four subject categories: technical-economic significance of the industrial production of flameproof textiles in the European community; inflammability of textile fibers; industrial methods for flameproofing textiles; and the flameproofing of textile fibers by graft polymerization. (LCL)

2824 (IRE-2/1973) ECONOMIC ASPECTS OF FOOD PRESERVATION BY GAMMA IRRADIATION. Schietecatte, W. (Institut National des Radioelements, Brussels (Belgium)). Feb 1973. 24p. (In Flemish). Dep. NTIS (U. S. Sales Only) $3.25.

Different economic aspects are discussed regarding the operating cost of the irradiation process, more particularly concerning gamma irradiation, with the object of prolonging the preservation and minimizing the microbiological deterioration of the foods. These data are illustrated by a few examples. In taking as a basis the advantages offered, as well as certain technico-economic and sanitary aspects, the distinction is made between the different technical and commercial elements which must be borne in mind at the time of choosing this system. Next, by reason of their importance at the time of conception and exploitation of a gamma irradiator, different factors are reviewed influencing the working costs and total investments. Generally, according to the advantages offered by gamma irradiation, the operating costs are not considered as an obstacle. However, the obtaining of acceptable operating costs depends on adaptation of the installation, its exploitation, and its high degree of utilization. (auth)

2825 INVESTIGATION OF HOLD-UP TIME IN HIGH-PRESSURE HYDROGENATION PLANTS. Gorski, B.; Beyer, C.; Ulrich, H. (Zentralinstitut fuer Isotopen und Strahlenforschung, Leipzig). Isotopenpraxis; 9: No. 8, 282-283(Aug 1973). (In German).

Investigation of liquid-phase hold-up time in high-pressure hydrogenation plants is reported. Choice of a suitable tracer isotope and labelling substance rendered possible investigations under operating conditions. Octadecanol-1 labelled ^{14}C was used as a tracer. The measuring method is described, and the plotted hold-up-time diagrams are discussed. (auth)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstract 2514.

2826 TRANSDUCTION OF METHICILLIN RESISTANCE IN STAPHYLOCOCCUS AUREUS. Wuest, J.; Kayser, F. H. (Univ., Zurich). Pathol. Microbiol.; 39: 4-5(1973). (In German).

By means of the phage 80, the genetic marker for methicillin resistance could be transferred to a methicillin sensitive receptor strain of Staphylococcus aureus. Donor strains stemmed from Switzerland, England, Australia, and the USA. The transduction succeeded only when the transduction lysate was exposed to uv radiation. The genetic code for resistance was localized in chromosomes. (HBG)

2827 RADIATION-INDUCED HYPERCHROMICITY OF DNA. Rafi, A. A.; Wheeler, C. M. (Univ. of New Castle upon Tyne, Eng.). Int. J. Radiat. Biol.; 24: No. 3, 321-323(Sep 1973).

Attention is drawn to discrepancies in G-values obtained during experiments on the radioinduced hyperchromicity of DNA, with particular reference to the importance of defining conditions under which DNA is considered native. Calf-thymus DNA (0.0075%) was irradiated (2 krads) in 10^{-3}M NaCl solution and diluted into salt concentrations from 10^{-3} to 10^{-1}M. The samples were then heated slowly to 95°C. It is pointed out that since the melting point of DNA depended on salt concentration, it is possible to choose for a base-line for measurement of hyperchromicity, any combination of salt concentration and temperature at which irradiation is still native. Since the amount of melting of DNA increases with both dose and temperature, it was possible to obtain G-values for loss of hyperchromicity from ~ 10 to 30 depending on conditions chosen. A tabulated comparison is presented for G-values calculated by various authors. (UK)

2828 CHARACTERISTICS OF UV INACTIVATION OF ACETYLCHOLINE ESTERASE IN ERYTHROCYTE MEMBRANES. Volotovskii, I. D.; Finin, V. S.; Sheiko, L. M.; Konev, S. V. (Inst. of Photobiology, Minsk). Dokl. Akad. Nauk BSSR; 17: No. 6, 569-572(Jun 1973). (In Russian).

It was shown that the relative quantum yield of the photoinactivation (B) of acetylcholine esterase (ACE) in membranes is controlled by the temperature in the interval from 10 to 35°C. The dependence obtained B = f(t) has an S-shaped form, characteristic for cooperative transitions, with $t_{½}$ at 18°C, and the ratio $B_{35°}/B_{10°} \sim 2$. Solubilization of the erythrocyte membrane with sodium desoxycholate (DOC), destroying the albumin-lipid contact, makes B independent of temperature. Comparison of the B of ACE in the membrane, in the albumin-lipid complex, and in solution, as well as in the presence of DOC during irradiation at different wave lengths (289 and 247 nm) made it possible to conclude that the level of photosensitivity of the ACE in the membrane, as well as the modification of the induction temperature, were determined by the character of the intermembrane albumin-lipid interaction, being changed by means of the structure cooperative transition at 18°C. The possible mechanisms of the effect of the lipid and its structural composition in the membrane on the photosensitivity of ACE were discussed. (tr-auth)

2829 STUDY OF X-IRRADIATED DNA USING FORMAMIDE GRADIENTS. Herman, R.; Rebeyrotte, N. (Institut du Radium, Paris). Biochem, Biophys. Res. Commun.; 55: No. 1, 150-153 (1 Nov 1973).

A density gradient of 70 to 100% (v/v) formamide was prepared for the study of both native and denatured bacterial DNA. Random single- and double-stranded breaks were introduced by treating the DNA with various doses of x-irradiation. A comparison was then made between two techniques of denaturation: by heating to 100°C followed by immediate cooling, and by gentle heating in high concentrations of formamide. No significant difference was found between the molecular weights of DNA molecules thus denatured. However, the development of this gradient provides a useful tool for centrifugation studies of denatured forms of DNA in a neutral, rather than alkaline environment. (auth)

2830 HUMAN ENDONUCLEASE ACTIVITY FOR GAMMA-IRRADIATED DNA. Brent, T. P. (St. Jude Children's Research Hospital, Memphis). Biophys. J.; 13: No. 4, 399-401(Apr 1973).

DNA was irradiated from a ^{60}Co source at a dose rate of 330 rad/min, and endonuclease activity was assayed by incubating the DNA with HeLa cell extract. A graph is presented to show the time-course of the HeLa endonuclease action on irradiated DNA. Graphs are also presented to show dose-response curves for production of radioinduced single-strand breaks and of breaks produced by radiation plus postirradiation endonuclease action. Results are compared with effects of endonuclease on uv-induced DNA strand breakage. (HLW)

2831 SOLUTE RADICAL INACTIVATION OF THE SULFHYDRYL ENZYME PAPAIN: SENSITIZATION AND PROTECTION. Gaucher, G. M.; Mainman, B. L.; Armstrong, D. A. (Univ. of Calgary, Alberta). Can. J. Chem.; 51: No. 15, 2443-2447(1 Aug 1973).

Particularly pure N_2O-purged papain solutions (2×10^{-5} M; pH 6.8) were irradiated at 0°C for different times with ^{60}Co γ-rays, in the presence of 10 to 30 mM solutions of acetate, isobutanol, and thiocyanate. In comparison to OH radicals, these solute radicals substantially enhanced papain inactivation. Calculated inactivation probabilities per papain-radical reaction (i.e., 0.43 for OH and 1.00 for solute radicals) support this finding. In situ protection of both N_2-purged and N_2O saturated papain solutions by cysteine was found to occur only at cysteine: papain molar ratios above 15 : 1, while below this ratio substantial sensitization occurred, reaching a maximum at a 2 : 1 ratio. This enhanced inactivation of papain at low cysteine concentrations is primarily repairable in nature, and probably due to CysS· attack on papain's active site sulfhydryl. Only at relatively high cysteine : papain ratios (>30) can protection be ascribed to radical scavenging. (auth)

2832 EFFECTS OF GAMMA IRRADIATION OF MYOGLOBIN. Lycometros, C.; Brown, W. D. (Univ. of California, Davis). J. Food Sci.; 38: No. 6, 971-977(1973).

Purified deoxygenated sperm whale myoglobin solutions were exposed to gamma irradiation at levels up to 500 krad. Following irradiation the solutions could be resolved by Sephadex chromatography into three fractions: monomer (molecular weight, M. W., estimate 17,000); dimer (M. W. 38,000); and polymers (M. W. 60,000 and greater). Dimer formation appeared to be intermediate to production of polymer fractions. All three fractions had the same spectral characteristics. Liganded derivatives of all three were less susceptible to change manifested by a lower Soret (409 nm) to protein (280 nm) absorbance ratio than was nonliganded metmyoglobin. The presence of excess ligand inhibited dimer and polymer formation, presumably due to the fact that such ligands may act as free radical scavengers. Irradiated myoglobin preparations showed many new bands on electrofocusing, underwent autoxidation at faster rates than controls, and were more susceptible to acid and thermal denaturation. Binding studies with n-butyl isocyanide suggested that irradiated myoglobin exhibits less steric hindrance than does control protein. (auth)

Radiation Effects on Cells

2833 (BNL-18234) BIOLOGICAL EFFECTS OF ^{252}Cf NEUTRONS. Fairchild, R. G.; Atkins, H. L.; Drew, R. M.; Robertson, J. S. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 14p. (CONF-731030-1). Dep. NTIS $3.00.

From second meeting on fundamental and practical aspects of the application of fast neutrons in clinical radiotherapy; The Hague, Netherlands (3 Oct 1973).

The biological effects of ^{252}Cf neutrons were studied with cultured cells, and with intact tissues. Measurements available to date, of the relative biological effect (RBE) and of the oxygen enhancement ratio (OER), are summarized and discussed. A table is presented to show the RBE of ^{252}Cf neutrons, compared to ^{137}Cs or ^{226}Ra, for HeLa cells, hamster cells, chromosome aberrations, leukemia cells, Vicia faba, intestinal crypt cells, and mouse spleen cells, as measured by pig skin tolerance. Graphs are presented to show survival of hamster cells under oxygenated and anoxic conditions after irradiation by ^{137}Cs and ^{252}Cf. (HLW)

2834 (COO-1671-51) RADIOBIOLOGICAL MODELING FOR HIGH LET THERAPY. Katz, R.; Sharma, S. C. (Nebraska Univ., Lincoln (USA)). 1973. 23p. (CONF-730952-3). Dep. NTIS $3.25.

From fourth symposium on microdosimetry; Pallanza, Italy (24 Sep 1973).

For the new therapeutic modalities (neutrons, negative pions, heavy ions) caution must be attached to the calculation of the equivalent dose of x rays yielding the same end point, for this must be known to a precision of 5% if it is to be useful to the therapeutic radiologist. One approach to treatment planning is to use the survival of an arbitrary cell line, representative of a critical tissue. A second approach is to convert this cellular survival to the equivalent dose of x rays yielding the same survival, under the specific set of irradiation conditions. Tests of the delta-ray theory of track structure with neutrons, pions, and heavy ions to date suggest that this is a promising route, both for the calculation of cell survival and for the equivalent dose. To this end, calculations have been made of the survival of HeLa, kidney, and leukemia cells in spread beams of D, He, O, and Ne ions, and of negative pions in a model therapeutic situation at which 30% of aerobically irradiated human kidney cells survive in the tumor region. The equivalent dose is different for these different mammalian cells by as much as 25%, for Ne, in the tumor region and at the entrance portal. The evaluation of different modalities may be based on differences in the survival of anoxically irradiated cells in the tumor region, and on the survival of normal cells in the tumor margins and at the entrance ports. The procedures outlined here can be extended to clinical situations. When applied to cells in culture, survival calculations from the theory appear to agree with observation to within the error of measurement. (auth)

2835 RELATIVE BIOLOGICAL EFFECTIVENESS OF FAST NEUTRONS FOR EFFECTS ON NORMAL TISSUES. Broerse, J. J.; Barendsen, G. W. (Radiobiological Inst. TNO, Rijswijk, Netherlands). Curr. Top. Radiat. Res. Quart.; 8: No. 4, 305-350(Jul 1973).

Studies on the relative biological effectiveness (RBE) of fast neutrons for effects on normal tissues revealed significantly different values which, in addition to the dose or dose per fraction, depend on the type of tissue investigated. These differences might partly be due to intrinsic differences of the dose response curves of the cells, which are responsible for maintaining the integrity and function of the tissues. RBE values of fast neutrons for effects on different types of normal tissues are compared and, where possible, analyzed with regard to underlying cellular phenomena. The majority of studies of RBE values of neutrons for effects on normal tissues were carried out with fission neutrons, cyclotron-produced neutrons with a mean energy of 8 MeV and monoenergetic 15-MeV neutrons produced by the D-T reaction. Some characteristics of the different fast-neutron beams are discussed with regard to neutron energy spectra, attainable dose rates, gamma contamination of the neutron beam and the energy dissipation patterns. In the LET distributions for the various neutron beams, two important regions can be distinguished, which correspond to the energy dissipated through collisions with protons and through interactions with the heavier nuclei, respectively. Under special conditions, the biological effects produced by the protons and by the heavier nuclei can be studied separately. Values of the relative biological effectiveness of fast neutrons for rapidly proliferating cells in various cell-renewal systems will be discussed and related to the radiation syndromes resulting from the depletion of the stem-cell compartment for the specific tissues. RBE values for bone marrow death and intestinal death are also discussed in relation to the influence of local perturbations of secondary charged particle equilibrium at the bone-soft tissue interface. It is concluded that dosimetric factors do not play a major part in determining the observed differences in RBE values for the two radiation syndromes. Studies of the survival of haemopoietic stem cells and intestinal crypt stem cells indicate that intrinsic differences in radiosensitivity exist between the types of cells investigated. Quantitative studies have only recently been initiated on the responses of tissues with much longer turnover times of functional cells, such as the vascular endothelium, the lung and the spinal cord. Some studies of late effects induced by fast neutrons in these tissues with slow turnover of cells are summarized and the RBE values are compared. Finally, the different RBE values for damage to various types of normal tissues are discussed with regard to the implications for fast-neutron radiotherapy. In order to evaluate the possible advantages of fast-neutron radiotherapy, it is necessary to compare the RBE of fast neutrons for eradication of the tumour with the RBE for the normal tissue which is dose-limiting in each particular case considered. (auth)

2836 EFFECT OF GAMMA IRRADIATION ON HUMAN CHROMOSOMES. VI. The Dependence of the Dose Fractionation Effect on the Stage of the Cell Cycle. Luchnik, N. V.; Sevan'kaev, A. V.; Nasonova, V. A. (Research Inst. of Medical Radiology, Obninsk, USSR). Genetika; 9: No. 8, 134-141(Aug 1973). (In Russian).

Human lymphocytes were gamma-irradiated with single doses (50, 100 or 200 rad) at different stages of the cell cycle or with a fractionated dose (150 + 50 rad) where the first dose was given at zero time and the second at different stages of the cycle. It was found that single irradiation at the end of G_1 stage produced very few exchanges of the chromosome type, whereas the number of fragments showed no decrease. In the case of a fractionated dose the number of interchanges fell to the base line level when the second dose was given in 20 to 25 hours and rose again when this dose was given in 27.5 to 30 hours. The number of fragments rose when the time interval between doses reached 30 hours. It is supposed that a conjugation between subunits of chromosome followed by their mutual proof takes place at the presynthetic stage. Probability of the exchange decreases during conjugation. It is concluded that transition from G_0 to G_1 stages is related to the beginning of conjugation. (auth)

2837 X-RAY INACTIVATION OF HUMAN CELLS IN TISSUE CULTURE UNDER AEROBIC AND EXTREMELY HYPOXIC CONDITIONS IN THE PRESENCE AND ABSENCE OF TMPN. Pettersen, E. O.; Oftebro, R.; Brustad, T. (Norsk Hydros Institut for Kreftforskning, Oslo). Int. J. Radiat. Biol.; 24: No. 3, 285-296 (Sep 1973).

A technique is described that permits irradiation of suspensions of human cells in tissue culture either aerobically (equilibrated with air) or under extremely hypoxic conditions (flushed with a mixture of 97% N_2 and 3% CO_2, the oxygen content of which was less than 15 ppm). An established cell-line, NHIK 3025, originally derived from an early stage of human carcinoma of the cervix, was used. The D_0 value of these cells under aerobic conditions was 130 rads and the extrapolation number about 3. Under extremely hypoxic conditions, the dose-effect curve was exponential with a D_0 value of 600 rads. The o.e.r. derived from the ratio of the D_0 values was therefore 4.6. 2,2,6,6,-Tetramethyl-4-piperidinol-N-oxyl (TMPN) at a concentration of 10^{-2}M exerted a pronounced sensitizing effect under extremely hypoxic conditions (TMPN e.r. = 2.5), and yielded dose-effect curves with an extrapolation number of 3. The high radioresistance of the cell under extremely hypoxic conditions in the absence of TMPN may be relevant to the evaluation of the radio-curability of tumors such as squamous cell carcinoma of the cervix uteri. (auth)

2838 MATHEMATICAL MODEL FOR THE FREQUENCY OF RADIATION CARCINOGENESIS AT LOW DOSES. Rosen, G. (Drexel Univ., Philadelphia). Math. Biosci.; 18: No. 1/2, 133-135 (Oct 1973).

The observed frequency of tumor incidence at low doses of radiation cannot be predicted by a statistical theory based exclusively on the frequency of carcinogenetic transformation in individual (independent) cells. It is pointed out that the observed effect-function dependence on the dose is predicted theoretically by an additive superposition of 1-cell and N-cell contributions. This is illustrated quantitatively by solving an idealized mathematical model in which the 1-cell and N-cell effect-probabilities are postulated to have very simple statistical forms. (auth)

2839 MOLECULAR ASPECTS OF THE MAMMALIAN CELL SURFACE. Mehrishi, J. N. (Univ. of Cambridge, Eng.). Progr. Biophys. Mol. Biol.; 25: 1-70(1972).

A review is presented of the biological implications of the cell surface molecular components. Radiation studies include radiosensitization, radioprotection, the involvement of sulfhydryl and amino groups, radiation and the suppression of the immune response, and radiosensitivity of lymphocytes. Other topics reviewed are: the electric charge and cell electrophoresis; experimental techniques; molecular components of the cell surface; glycoprotein coat of the cell membrane; neoplasia and the cell surface; human leucocytes; human blood platelets; cell adhesions; membrane fusion; and rapid data handling. (approximately 300 references) (HLW)

2840 UNSCHEDULED DNA SYNTHESIS AND REPAIR REPLICATION IN UV-IRRADIATED CHINESE-HAMSTER CELLS. Rommelaere, J.; Errera, M. (Univ., Brussels). Arch. Int. Physiol. Biochim.; 81: 200-202(Feb 1973).

Following ultraviolet irradiation of cultured hamster cells, the following observations were made: a low level of unscheduled DNA synthesis and repair replication; the increase of both phenomena after substitution with BUdR in the DNA; the unscheduled DNA synthesis and repair replication were quantitatively correlated; and the number of nucleotides inserted during the repair of one BUdR photo-product could be estimated. (HLW)

2841 GROWTH AND RADIATION SURVIVAL CHARACTERISTICS OF CELLS IN AN IN VITRO TUMOR MODEL. Durand, R. E. London, Ont.; Univ. of Western Ontario (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The crowded growth conditions, altered blood supply, and lack of growth regulation of many solid tumors produce a cell population heterogeneous in morphology, proliferation kinetics, oxygenation, and nutrition. The influence of these factors on cell growth and radiation survival characteristics can easily be studied using an in vitro suspension culturing technique that produces multicellular 'spheroids' of complexity intermediate to standard cell cultures and animal tumors. Development of central necrosis was dependent on available metabolites, and under optimal conditions of nutrition the viable rim of cells was found to vary as the square root of oxygen concentration, in agreement with theoretical predictions. Electron microscopy showed that 'close' and 'tight' junctions developed, as did intercellular contacts similar to desmosomes. Irradiated spheroids were reduced to single cells by trypsinization, and survival was assayed by colony formation. Cells grown in contact for as little as one day developed a higher capacity for accumulation of sublethal radiation damage as reflected by survival curves with extrapolation numbers (and hence survival at large doses) increased by 15-fold. Irradiation of synchronized spheroids showed that the contact effects were variable through the cell cycle, and that recovery from sublethal radiation damage was maximum at late S phase. The G_0 population that developed in larger spheroids was found to be relatively radiosensitive, as were early G_1 phase synchronous spheroids. However, in very large spheroids, the internal G_0 cells became hypoxic and thus highly radioresistant. Large spheroids thus contained cells in three subpopulations which could be selectively studied by killing cycling S phase cells with hydroxyurea, or by varying the fraction of hypoxic cells by changing the oxygen tension in the growth medium, varying the temperature to alter oxygen consumption, reoxygenating the cells by reducing the spheroid to single cells, or by specific sensitization of the hypoxic cells with electron affinic chemicals. Spheroids thus contain cells growing under conditions of oxygenation, nutrition and intercellular contact similar to many solid in vivo tumors. In addition, the ability to maintain precise growth and irradiation conditions plus the fact that survival of individual cells can be studied suggests that spheroids provide a tumor model of unique potential for determining proliferation and survival characteristics of therapeutically treated or untreated cells. (Diss. Abstr.)

2842 LUNG COLONY ASSAYS OF MURINE MAMMARY TUMOR CELLS IRRADIATED IN VIVO AND VITRO. Shaeffer, J.; El Mahdi, A. M.; Constable, W. C. (Univ. of Virginia, Charlottesville). Radiology; 109: No. 3, 703-706(Dec 1973).

C3HBA tumor cells were irradiated either in vitro prior to their intravenous injection or in vivo by whole lung irradiation 24 hours after their intravenous injection into isologous tumor-free C3H/HeJ female mice. The animals were sacrificed 28 days following treatment, and the number of lung colonies in each treatment group was expressed as the percentage of lung colonies present in untreated (control) mice. Both in vivo and in vitro survival curves had similar values of D_0, but had different extrapolation numbers which were 3.4 and 1.0, respectively. Possible underlying causes for the difference in survival curves are discussed. (auth)

Radiation Effects on Microorganisms

Refer also to abstract 4727.

2843 (CEA-CONF-2286) EFFECTS OF HIGH γ IRRADIATION DOSES ON THE MAMMARY MURINE TUMOR VIRUS. Gorka, C.; Mistry, P.; Mouriquand, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1972. 16p. (In French). (CONF-720691-1). Dep. NTIS (U. S. Sales Only) $3.00.

From 7th international conference on mammary tumors; Saint-Pierre-de-Chartreuse, France (12 Jun 1972).

Cellular extracts of mammary tumors of the PS mouse strain and suspensions of purified viral particles obtained using ultracentrifugation were γ irradiated with 150 to 3950 kR doses. The infectivity was not only retained but actually enhanced with increasing dose: 1200, 1950, and 2500 kR. The mean age of the tumors was reduced. Electron microscopy enabled observations to be made of numerous type A and type B particles. The molecular weight of the radiation sensitive sample is less than that of ribosomal RNA; this fact indicating the possibility of only a small fraction of the viral RNA being implicated in the oncogenic function of the virus. (FR)

2844 (TID-26471) MOLECULAR BASIS FOR THE MUTAGENIC AND LETHAL EFFECTS OF ULTRAVIOLET IRRADIATION. Progress Report, January 1—October 4, 1973. Grossman, L. (Brandeis Univ., Waltham, Mass. (USA). Graduate Dept. of Biochemistry). 1973. Contract AT(11-1)-3232. 9p. Dep. NTIS $3.00.

Progress is reported on the following research projects: incision of DNA by endonucleases specific for uv-irradiated DNA in Escherichia coli; isolation, characterization, and identification of uv-endonuclease as a gene product; biological assay for repair of uv-irradiated DNA of ϕ X 174 phage; removal of pyrimidine dimers from incised uv-irradiated DNA by DNA polymerase; and reinsertion of nucleotides into cavities in DNA strands created by excision. (HLW)

2845 REPAIR OF X-RAY DAMAGE TO BACTERIAL DNA. Town, C. D.; Smith, K. C.; Kaplan, H. S. (Stanford Univ., CA). Curr. Top. Radiat. Res. Quart.; 8: No. 4, 351-399(Jul 1973).

Of the lesions produced in DNA by ionizing radiation, the one most extensively studied to date, and most closely correlated with cell killing, is the breakage of one or both strands of the sugar-phosphate backbone. DNA strand breaks may occur in different locations, with corresponding differences in the size of the strand interruption and in the chemical nature of the residual end groups. These differences call different enzymes systems into play to restore the integrity of the polynucleotide chain. Unrepaired single-strand breaks in DNA may be lethal for the cell; cell killing is significantly increased when repair is genetically or physiologically deficient or is inhibited by post-irradiation treatment with certain chemicals. Using selected mutants of Escherichia coli, it has been shown that essentially the same numbers of single-strand breaks are produced by x rays in the presence or absence of oxygen. After irradiation, these are rejoined to different extents by three operationally distinct repair processes, designated Types I, II and III. Type I repair, the fastest, goes to completion in less than one minute at 0°C. Since it preferentially rejoins breaks produced under anoxic conditions, its effect is to leave about one-third as many single-strand breaks remaining in cells irradiated under anoxic versus aerobic conditions. Preliminary evidence suggests that it may involve the action of DNA polynucleotide ligase. Of the breaks remaining unrepaired, whether produced anoxically or aerobically, about 90% are acted upon by the Type II system, which is also relatively fast ($T_{\frac{1}{2}} = \sim$ 1-2 min at room temperature), does not require growth medium, and is largely deficient in polA mutants. Type III repair requires 30-60 min of incubation in growth medium at 37°C. It is absent in exr mutants and also in recA mutants which are deficient in genetic recombination. It is capable of repairing only a small fixed number of breaks (approximately 2 breaks per single-strand genome), whether produced anoxically or aerobically. Genetic and pharmacological evidence suggests that the recA gene is also required in an additonal repair process, which does not involve DNA single-strand breaks. Several recently developed experimental systems which may permit the further elucidation of these enzymatic repair processes under partially in vitro conditions are discussed. (auth)

2846 EFFECT OF POSTIRRADIATION INCUBATION ON UV SENSITIVITY OF ESCHERICHIA COLI STRAINS DEFICIENT IN DIFFERENT STEPS OF DARK REPAIR. Smirnov, G. V.; Fil'kova, E. V.; Skavronskaya, A. G. (Inst. of Epidemiology and Microbiology, Moscow). Genetika; 9: No. 8, 100-104(Aug 1973). (In Russian).

The uvr 502 mutants of Escherichia coli, which have reduced ability to repair DNA single-strand breaks introduced in the course of the incision step of excision repair, show a higher survival after uv-irradiation when plated on a minimal glucose-salt medium than when plated on nutrient agar. The extent of minimal medium recovery (MMR) in the uvr 502 strain was several times lower than in the uvr A6 mutant. Introduction of the uvr 502 mutation in the uvr A6 strain reduced the extent of MMR to the level observed for the single uvr 502 mutant. In contrast to the MMR of uvr A6 mutant, MMR of the uvr 502 mutant remained unaffected after the introduction of the recA⁻ or recB⁻ mutations in the uvr 502 genetic background. (auth)

2847 REDUCED DIMER EXCISION IN BACTERIA FOLLOWING NEAR ULTRAVIOLET (365 nm) RADIATION. Tyrrell, R. M.; Webb, R. B. (Argonne National Lab., IL). Mutat. Res.; 19: No. 3, 361-364(Sep 1973).

The experiment consisted of uv-irradiating Escherichia coli at 365 nm and then inducing substrate for the excision system in DNA by 254 nm radiation. The samples were then assayed for excision. The ability of E. coli to excise dimers induced in DNA by 254 nm radiation was progressively reduced as a function of the dose of 365 nm radiation. The dose of radiation required for the elimination of detectable excising ability was approximately the same as the threshold dose for exponential inactivation. The chemical evidence supports the hypothesis that excision repair rapidly becomes ineffective at biologically significant doses of 365 nm radiation. (HLW)

2848 EFFECT OF REC MUTATIONS ON THE ULTRAVIOLET PROTECTING AND MUTATION-ENHANCING PROPERTIES OF THE PLASMID R-UTRECHT IN SALMONELLA

TYPHIMURIUM. MacPhee, D. G. (La Trobe Univ., Bundoora, Australia). Mutat. Res.; 19: No. 3, 357-359(Sep 1973).

Derivatives of strains of S. typhimurium with and without R-Utrecht were tested for their ability to yield uv-induced back mutations of the amber mutation. Results showed that R-Utrecht significantly enhanced the uv mutability of one strain, but cells of another strain were stable to the mutagenic effects of uv whether or not R-Utrecht is present. It was concluded that because the R-Utrecht factor does not restore uv resistance or uv mutability to the recA-type mutants, it seems unlikely that the effects of the R factor on the uv response of wild-type cells could be due to a plasmid gene whose product is functionally equivalent to that of the chromosomal recA. (HLW)

2849 REVERTANTS OF AN ESCHERICHIA COLI K-12 STRAIN WITH HIGH SENSITIVITY TO RADIATIONS AND CHEMICALS. Mohn, G. (Zentrallaboratorium fuer Mutagenitaetspruefung der DFG, Freiburg i. B.). Mutat. Res.; 19: No. 3, 349-355(Sep 1973).

The repeated isolation of mutants sensitive to radiation and also showing high spontaneous mutability indicated that in corresponding wild types some spontaneously occurring premutational lesions are repaired in a way similar to that for lesions induced chemically and by radiation. The question as to whether the high sensitivity and high mutability are pleiotropic manifestations of a single mutation or the results of different but closely linked mutations was investigated. Revertants were treated with x radiation, ethyl methanesulfonate, isopropylmethanesulfonate, methyl methanesulfonate, N-methyl-N′-nitro-N-nitrosoquanidine, N-methyl-N-nitrosourea, and 5-methyl-DL-tryptophan. Figures are presented to show survival following treatment with these agents. (HLW)

2850 DIPLOIDY AND REPAIR OF RADIATION DAMAGE IN SACCHAROMYCES MUTANTS. Averbeck, D.; Ebert, M. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Mutat. Res.; 19: No. 3, 305-312(Sep 1973).

Diploid wild-type cells of Saccharomyces and cells homozygous for one of the single genes r_1^s, r_2^s of the two alleles of the r_3^s gene (rad 2 gene) were tested for their response to ionizing irradiation in the presence and absence of oxygen. Both immediate and delayed plating (agar-holding) techniques were used. An identical oxygen enhancement ratio (OER) of 2.5 was observed in $r_1^s r_1^s$, $r_2^s r_2^s$ cells and the wild type. In $r_{3-1}^s r_{3-1}^s$ and $r_{3-2}^s r_{3-2}^s$ cells the OER was reduced. Their sensitivity to ionizing irradiation in oxic conditions was the same as that of the wild type. $r_2^s r_2^s$ cells showed an increase in relative sensitivity by a factor of 4 in both conditions of irradiation. The relative sensitivity of $r_1^s r_1^s$ cells was increased by a factor of 2.5 in hypoxic conditions and the sensitivity in hypoxia was identical to that of wild type cells in oxic conditions. In contrast to haploid r_1^s cells the oxygen effect was fully expressed in diploid $r_1^s r_1^s$ cells. The results on diploid strains are discussed in terms of three independent genetically determined repair systems in Saccharomyces. The expression of these systems is influenced by ploidy (auth)

2851 THERMAL INACTIVATION OF UNTREATED AND GAMMA-IRRADIATED A2/Aichi/2/68 INFLUENZA VIRUS. De Flora, S.; Badolati, G. (Univ., Genoa). J. Gen. Virol.; 20: No. 2, 261-265(Aug 1973).

The infectivity and the hemagglutinin activity of A2/Aichi/2/68 influenza virus were unchanged during a 2-year storage in allantoic fluid at -80°C. Over the temperature range from -20 to +30°C, exponential slopes could be drawn by means of the regression analysis, the velocity constants showing very low values. Conversely, at +56°C inactivation took place in a two-component fashion, each following first-order kinetics. Hemagglutinin and neuraminidase activities were not impaired by exposure to $[^{60}Co]$ γ rays (3×10^6 rad), which completely removed infectious particles. The specific rate constants for inactivation of hemagglutinin and neuraminidase activities of untreated and irradiated virus were overlapping when samples were stored for 2 yrs in the frozen state (-80 and -20°C), whereas a significantly increasing rate of inactivation was recorded for γ-irradiated samples following storage at temperature above 4°C. Nevertheless, the energy of activation required for thermal inactivation was very low and the entropy of activation showed negative values for both the untreated and the irradiated virus preparations. (auth)

2852 OCCURRENCE OF DOUBLE-STRAND BREAKS IN COLIPHAGE T1 DNA BY IODINE-125 DECAY. Schmidt, A.; Hotz, G. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Radiat. Biol.; 24: No. 3, 307-313(Sep 1973).

DNA of coliphage T1 was labeled with ^{125}I-iododeoxyuridine. Inactivation of plaque forming ability and sedimentation behavior of DNA was studied during the radioactive decay of ^{125}I. The absence of a temperature effect as well as the observation that a radical scavenger does not influence inactivation supports the view that ionizing radiation is not responsible for loss of phage viability. However, experimental evidence is given for DNA double-strand breaks being the relevant lethal event caused by electron vacancy cascades (Auger effect). The ratio of single- to double-strand breaks was calculated to be 1.1 : 1. The relationship of 1 : 1 was found between the numbers of lethal events and of double-strand breaks. (auth)

2853 LETHAL EFFECTS OF ARTIFICIAL ULTRAVIOLET RADIATION ON CEREAL RUST UREDOSPORES. Maddison, A. C.; Manners, J. G. (Univ. of Southampton, Eng.). Trans. Brit. Mycol. Soc.; 60: No. 3, 471-494(Jun 1973).

Monochromatic far and near ultraviolet and polychromatic radiation reduced uredospore (urediniospore) germinability in Puccinia striiformis West., P. recondita Rob. & Desm. f. sp. tritici Eriks. & Henn., and P. graminis Pers. f. sp. tritici Eriks. & Henn., survival decreasing approximately logarithmically beyond an initial shoulder on the dose-survival curve. Infectivity was three to six times more sensitive than germinability to germicidal lamp radiation. Sensitivity to germicidal lamp radiation in P. striiformis was independent of temperature, but was greater at high relative humidities than at low. Reciprocity of time and dose rate was demonstrated when this species was subjected to such radiation. Action spectra for loss of germinability suggested nucleic acids and proteins respectively as chromophores in P. striiformis and P. graminis: data from photoreactivation experiments implied nucleic acid involvement in both species. Sunlamp and simulated sunlight exposures showed uredospores to be sensitive to naturally occurring wavelengths at dose levels received at the earth's surface. The ratio of the doses necessary to reduce germinability to 10% of the control value for P. striiformis, P. recondita, and P. graminis uredospores was 1.0 : 1.5 to 2.2 : 3 to 3.5 after irradiation by the various sources. (auth)

2854 ADDITIVITY OF TYPE O AND TYPE N DAMAGE IN DIPLOID YEAST. Kiefer, J.; Averbeck, D. (Univ., Giessen, Ger.). Int. J. Radiat. Biol.; 24: No. 3, 325-328(Sep 1973).

Saccharomyces cerevisiae (wild-type strain 211) in a stationary phase was exposed to 12-MeV electrons over a dose range of 0. to 700 rads. In one set of experiments a first dose was given in air and a second 15 min later in nitrogen. In a second set of experiments, the first dose was in N_2 and the second in air. Survival curves were established by varying the size of the second dose. The shoulder of anaerobic curve was completely abolished by pre-irradiation with moderate doses in air. It is suggested that these results indicate a complete overlap of type O and N damage in both directions suggesting that both share a damage pathway in the cell, probably, but not necessarily acting on the same target molecule. (UK)

2855 LET FACTOR IN MUTAGENESIS BY IONIZING RADIATIONS. 1. Reversion to Wild Type of a Bacteriophage T4 Amber Mutant. Munson, R. J.; Bridges, R. A. (Medical Research Council, Harwell, Eng.). Int. J. Radiat. Biol.; 24: No. 3, 257-273(Sep 1973).

Mutations to wild type of an amber mutant E51 of phage T4 were induced by ionizing radiation after the phage DNA had been injected into cells of a permissive host, Escherichia coli K12 CA 266. Phage bacterial complexes were deposited as monolayers on Millipore filters and exposed to alpha particles or protons of well-defined energies covering a range of LET values from 10 to 230 keV/μm, or to ^{60}Co gamma rays. Complexes were then plated on lawns of CA 266 bacteria for estimation of surviving E51 phage and on lawns of CA 244 bacteria, which were permissive only for wild-type phage, for the scoring of back mutations. The frequency of radiation-induced mutants was proportional to dose with all types of radiation. The observed mutagenic effectiveness of the heavy charged particles relative to gamma rays fell steadily with increasing LET to a value of 0.43 at 230 keV/μm. This LET dependence was compared with theoretical curves calculated on different assumptions with respect to the type of initial DNA lesion from which a mutation arises. It was concluded that a mutagenic lesion is induced by one ionizing particle that damages one DNA strand as it passes through a phage genome at a point that is probably within or close to its amber triplet. (auth)

2856 PROBLEMS IN FOOD IRRADIATION. Gerner, K. Mitteilungsbl. GDCh (Ges. Deut. Chem.)-Fachgruppe Lebensmittelchem. Gerichtl. Ch; 26: No. 10, 189-196(1972). (In German).

Within the framework of a report on a meeting of the study group Berlin of the GDCh task group on "Food Chemistry and Forensic Chemistry", a lecture given by Guenter E. Mueller on "Problems in Food Irradiation" is reviewed. The lecture gives a brief survey of the development and present state of food irradiation, particularly discussing the question of the wholesomeness of irradiated food which has been tested in numerous animal experiments in various countries. It has been shown that toxic by-products will occur only after the application of radiation doses exceeding the doses normally applied for disinfection, pasteurization, or sterilization. The radioinduced chemical changes in foodstuffs are described and compared with changes due to chemical preservatives and heat treatment. The sensitivity of various foodstuffs to irradiation as well as the phenomenon of the "radiation taste" of certain foodstuffs due to higher radiation doses are discussed. A detailed account is given of the different methods and doses applied for various purposes such as sprout inhibition in potatoes, extension of shelf-life of seafish, disinfection of spices and drugs, and inhibition of germs in fruit. A review of the legal provisions governing the approval of irradiated food in the FRG as well as in other countries is followed by a list of irradiated foodstuffs already authorized for sale in some countries. (GE)

2857 DETECTION OF CORN STARCH IRRADIATED WITH LOW DOSES OF GAMMA RAYS. Winchester, R. V. (Atomic Energy Board, Pelindaba, S. Afr.). Staerke; 25: No. 7, 230-233(1973).

A modification of the existing thiobarbituric acid test for irradiated starch was devised that eliminates interference caused by side reactions of the thiobarbituric acid and that does not require a sample of unirradiated starch as a standard for comparison. Doses as low as 10 krad were successfully detected. (auth)

2858 CYTOPLASMIC PETITE INDUCTION IN RECOMBINATION-DEFICIENT MUTANTS OF SACCHAROMYCES CEREVISIAE. Moustacchi, E. (Institut du Radium, Orsay, France). J. Bacteriol.; 115: No. 3, 805-809(Sep 1973).

As compared to the original wild type, the induction of the cytoplasmic "petite" mutation by ultraviolet light and by the intercalating dye, ethidium bromide, is reduced in two mutants (rec4 and rec5) of Saccharomyces cerevisiae. These mutants are blocked in x-ray or ultraviolet light-induced intragenic recombination. It then appears that the products of nuclear genes necessary for the completion of nuclear intragenic recombination events are also involved in steps of the metabolic chain that lead to the mitochondrial mutation ρ^-. (auth)

2859 TRANSDUCTION OF LACTOSE METABOLISM IN STREPTOCOCCUS LACTIS C2. McKay, L. L.; Cords, B. R.; Baldwin, K. A. (Univ. of Minnesota, St. Paul). J. Bacteriol.; 115: No. 3, 810-815(Sep 1973).

Ultraviolet (uv)-induced phage lysates, from lactose-positive (lac^+) Streptococcus lactis C2, transduced lactose fermenting ability to lac^- recipient cells of this organism. Although the phage titer could not be determined due to the absence of an appropriate indicator strain, the number of transductants was proportional to the amount of phage lysate added. Treatment of the lysate with deoxyribonuclease had no effect on this conversion, indicating the observed genetic change was not mediated by free deoxyribonucleic acid. When the lac^+ transductants were isolated and exposed to uv irradiation, lysates with higher transducing ability were obtained. The transducing ability of this lysate was about 100-fold higher than that observed in the original lysates. The lac^+ transductants were unstable since lac^- segregants occurred at high frequency. The phage lysate from S. lactis C2 also transduced maltose and mannose metabolism to the respective negative recipient cells. The results demonstrate the transduction of carbohydrate markers by a streptococcal phage and establish a genetic transfer system in group N streptococci. (auth)

2860 INTEGRATION EFFICIENCY IN DNA-INDUCED TRANSFORMATION OF PNEUMOCOCCUS. II. Genetic Studies of Mutant Integrating All the Markers with a High Efficiency. Tiraby, G.; Sicard, M. A. (Univ., Toulouse). Genetics; 75: No. 1, 35-48(Sep 1973).

Transformation of the pneumococcus mutant 401 by DNAs bearing the standard reference marker and several other markers belonging to two unlinked loci has shown that differences in the integration efficiencies of these markers were considerably reduced in this strain compared to the wild-type strain Cl_3. The sensitivities of mutant 401 to uv light and to x-ray irradiation are the same as those of Cl_3. However, in 401 all the markers tested are more resistant to inactivation as shown by transformation of 401 and Cl_3 by uv-irradiated DNA. The increase in resistance is greater for low efficiency (LE) markers than for high efficiency (HE) markers. The decreased discrimination between LE and HE markers in strain 401 is not due to a mechanism related to modification of markers in the transforming DNA by the recipient cells, nor are the proteins inducing competence of the cells responsible for the differences in the integration efficiencies of various markers. Genetic studies of the fate of recombinants as well as the measure of the amount of DNA taken up have shown that all the markers are integrated in strain 401 by the same recombination process, that specific to high efficiency markers. (auth)

Radiation Effects on Plants

Refer also to abstract 2833.

2861 (COO-1313-37) EFFECTS OF GAMMA-IRRADIATION ON DNA TRANSCRIPTION AND RNA TRANSLATION IN PLANTS. Final Report. Cherry, J. H. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Horticulture). 1973. Contract AT(11-1)-1313. 9p. Dep. NTIS $3.00.

For the first six years the research program dealt mainly with the effects of ionizing radiation on the synthesis of nucleic acids and protein in plants. The long range objectives were to determine whether x-irradiation altered protein synthesis via a direct action on the nucleic acids. Initially, the research concerned the characterization of nucleic acids in plant cells. Subsequently it was shown that x-irradiation inhibited protein synthesis in peanut cotyledons by decreasing their capacity to produce functional mRNA. In another system (excised tissue of the sugar beet tuber) it was shown that x-irradiation (100 kR) reduced endogenous RNA polymerase of chromatin preparations by 50% and the available template for RNA transcription of chromatin by 35%. During the last three years research centered on the effects of γ-irradiation on the transcription of DNA. These studies focused on the activity of chromatin-bound and soluble RNA polymerases, and RNA protein synthesis as affected by exposure of sugar beet tissue to γ-irradiation. (auth)

2862 (STI/PUB-320) NUCLEAR TECHNIQUES FOR SEED PROTEIN IMPROVEMENT. Proceedings of a Research Coordination Meeting, Neuherberg, 26–30 June 1972. Panel Proceedings Series. (International Atomic Energy Agency, Vienna (Austria)). Jun 1973. 429p. (CONF-720694-). IAEA $16.00.

Separate abstracts were prepared for 9 of the 33 papers presented in these proceedings. The other papers discuss various methods of mutation breeding for the improvement of seed protein quantity and quality. (ERB)

For abstracts of individual papers see: 2427, and 2871–2878.

2863 EXPERIMENTALLY INDUCED MUTATIONS OF APPLE TREE. Kolontaev, V. M. (State Pedagogical Inst., Tambov, USSR). Genetika; 9: No. 8, 158-160(Aug 1973). (In Russian).

Three groups of mutations were induced in apple tree by x rays and chemical mutagens. These changes are inherited in the course of vegetative reproduction. (auth)

2864 RECESSIVE CHLOROPHYLL MUTATIONS IN THE SEED PROGENY OF M_1 PLANTS OF SPRING VETCH. Debelyi, G. A.; Ptashenchuk, V. N. (Research Inst. of Agriculture of the Central Regions of the Non-Chernozem Zone, Nemchinovka, USSR). Genetika; 9: No. 8, 45-49(Aug 1973). (In Russian).

The comparative mutagenic efficiency of gamma rays and several different chemical mutagens, as well as that of their combined effect as the result of treatment of spring vetch seeds, was studied. Recessive chlorophyll mutants in M_2 were used as test plants. The materials for sowing were seeds from separate fertile nodes and branches, their position on the stem being recorded. The data obtained indicate the necessity of further investigations and the practical significance of the method of combined treatment of seeds with different mutagens. (auth)

2865 RADIATION-INDUCED POLLEN ABORTION IN SEVERAL COMMELINACEOUS TAXA: ITS RELATION TO CHROMOSOMAL PARAMETERS. Underbrink, A. G.; Sparrow, A. H.; Pond, V.; Takahashi, C. S.; Kappas, A. (Columbia Univ., New York). Radiat. Bot.; 13: No. 4, 215-227(Aug 1973).

The effects of x or gamma rays and 0.43-MeV neutrons on pollen abortion, as measured by cotton blue staining, were studied in fifteen members of four genera (Floscopa, Gibasis, Tradescantia, and Tripogandra) of the family Commelinaceae. The roles of interphase chromosome volume (ICV), nuclear volume (NV), and ploidy on the degree of pollen abortion induced by radiation were investigated. For each species, the maximum percentage of aborted grains was determined over a postirradiation period equivalent to an entire period of microsporogenesis. Dose-response curves were constructed for each species and these were found to vary in slope. From these curves, RBE values were determined for two species of Tradescantia and for a diploid and tetraploid species of Gibasis. Within the dose range investigated, highest RBEs at 10% pollen abortion ranged from about 23 for Gibasis karwinskyana (4x) to about 9.4 for the diploid Gibasis. Ploidy was not found to influence the radiation response to an appreciable extent when ICVs were similar. High polyploids with small ICVs were found to be more radioresistant, but this response appears to be a function of ICV and not the degree of ploidy. Correlations were sought between 50% pollen abortion and ICV or NV. No correlations were found using NV. However, following low LET radiation an inverse relationship (-1 slope) was obtained between 50% pollen abortion and ICV. The same relation appears to hold for neutrons, but since only four species were available for comparison this relationship is still inconclusive. (auth)

2866 THEORETICAL BASES AND PRACTICAL RESULTS OF THE PRE-IRRADIATION OF SEEDS WITH GAMMA RAYS IN USSR. Kuzin, A. M.; Berezina, N. M.; Kaushanskii, A. D.; Lysikov, V. N.; Sukach, K. I. (Inst. of Biological Physics, Moscow). Stimulation Newslett.; No. 4, 1-11(1972).

For the last 15 years, a series of experiments has been conducted in the USSR for studying the instability of the radiation stimulation effect. It has been shown that the optimal radiation doses depend on various factors e.g. moisture content and age of seed, dose rate, time interval between irradiation and sowing. In 1970, instructions on the pre-irradiation technique were worked out and published, which consider all known factors. Particular attention was given to the theoretical basis of the stimulating effect of irradiation. Non-specific and specific low-molecular effectors start the mechanism, in which enzymes necessary for the transition to the next developmental stage play an important role. A scheme was constructed describing the structural-metabolic concept on the stimulation. These investigations served as a theoretical basis for practical use. The mobile gamma-source "Kolos" was constructed for irradiation in 1966-1967, its principle of operation is described. The "Kolos" installation was tested for 3 yrs. The results of these tests are represented and discussed. (GE)

2867 EFFECTS OF ACUTE X IRRADIATION UPON GROWTH OF PARTHENOCISSUS TRICUSPIDATA AXILLARY BUDS. II. Anatomical Damage and Recovery. Langenauer, H. D.; Haskell, D. A.; Osborne, T. S. (Smith Coll., Northampton, MA). Radiat. Bot.; 13: No. 4, 197-205(Aug 1973).

Axillary buds of different development stages of Boston ivy seedlings were exposed to acute 600 R of x irradiation or injured mechanically. Both types of treatment to the buds could result in shoot growth with missing or displaced organs or a defunct apical meristem (blind shoot). Only ionizing radiation could produce adventitious organs or bifurcations. Mechanical injury to the buds damaged only organs on the shoots that were present in the bud at treatment time, while radiation damage appeared in organs yet unformed in the bud at the time of exposure. Histological studies of the buds showed that in the apex there was equal radiation damage to surface and subsurface layers with the central zone more sensitive than the flanks. Damaged cells were scattered through young primordia. Recovery was defined as the ability of a shoot to resume normal growth, and occurred earlier in time in apices and shoots of buds treated in later developmental stages than in younger-treated ones. Deviations from normal growth on recovered shoots occurred for only portions of the stem and were attributed to morphological alterations and not induced somatic mutations. Radio-resistance of the bud was measured by its ability to produce a shoot with a viable meristem; either the original apex or a substitute. Buds treated at older stages were less sensitive than younger-treated ones. This difference was attributed to a larger cell population, greater apical size during recovery, and faster growth. Nuclear or chromosome volume was apparently not a factor. (auth)

2868 PRELIMINARY REPORT ON CYTOHISTOGENETIC EFFECTS OF X RAYS ON SHOOT APICES OF TRIGONELLA FOENUM-GRAECUM L. Sarkar, A. (Bose Inst., Calcutta). Sci. Cult. (Calcutta); 39: No. 5, 222-224(May 1973).

Seeds of Trigonella foenum-graecum were x-irradiated at doses of 25 to 150 RR and effects on growing seedlings were observed. Morphological changes such as aberrant leaves and fasciation of the stem were noted. Shoot apices were prepared for cytological and histological studies and microscopic examinations revealed many damaged cells in the inner tunica layer, inhibition of mitosis, multinucleate cells, dead cells in the apical meristem, and other abnormalities. Plants treated with 100 kR or higher doses did not survive. (HLW)

2869 COMPARATIVE STUDY ON THE SEED PROTEINS OF INDUCED MUTANTS OF THE PEA. Puskas, M.; Dudits, D.; Balint, A. (Semmelweis Univ., Budapest). Acta Biol. Acad. Sci. Hung.; 23: No. 4, 343-352(1972).

A number of morphological and physiological mutants were produced from the Iregi P_1 breed of the feeding pea by x-ray irradiation and ethyl methanesulphonate treatment. The harvest of two experimental years from 20 of these mutants was analyzed biochemically. The disc-electrophoretic studies on the albumin and globulin content of the seeds showed significant qualitative differences, while the analysis of total protein and amino acid content revealed marked quantitative differences between the mutants of each when compared to the initial line. (auth)

2870 SOMATIC MUTATIONAL TRANSIENTS. III. Response by Two Genes in a Clone of Nicotiana to 24 Roentgens of Gamma Radiation Applied at Various Intensities. Sand, S. A.; Smith, H. H. (Roswell Park Memorial Inst., Orchard Park, NY). Genetics; 75: No. 1, 93-111(Sep 1973).

Somatic effects of radiation intensity on the mutable V and stable R genes were detected in plants of a heterozygous clone (v_{53}/v_{s}, R/r) subjected to the same dose at four rates. The effects were compared by counting speckled and purple sectors in flowers from irradiated and control plants. Response curves were estimated from the mutant sector averages, observed over a period of transient response for successive mature flowers. A structure for integrating the mutational contributions from different flowers was provided by models. The average control mutation rates are 8,110 per 10^7 cells for the V gene, and 49.45 for R. At a constant intensity of 4320 R/hr, average induced mutation rates per 10^7 cells per roentgen for V increase from 194 (at 24 R total dose) to 1,116 (at 3 R dose); the corresponding rates for R increase from 7.24 to 27.65. With these responses as standards, both genes at corresponding total doses yield lower rates at lower intensities. For the series of intensities 1.2, 0.6, 0.3, and 0.15 R/hr, the decreases in mutation rate for the V gene are, respectively, 66, 148, 315, and 617 per 10^7 cells per roentgen. The corresponding decrements for R are 4.86, 8.70, 14.61, and 23.51. These effects are non-linear functions of intensity for both genes, but V is at least 13 times as sensitive as R. Radiation operating to extinguish a buffering system against final mutation can account for the dose and dose-rate effects observed. (auth)

2871 MUTATION BREEDING FOR HIGH-PROTEIN RICE VARIETIES. Chu, Y. E.; Wu, S. C.; Tsai, K. S.; Li, Y. S. (Inst. of Botany, Taipei, China). pp 145-147 of Nuclear Techniques for Seed Protein Improvement. Vienna; International Atomic Energy Agency (1973).

From research coordination meeting on nuclear techniques for seed protein improvement; Neuherberg, F.R. Germany (26 Jun 1972). See STI/PUB-320; CONF-720694-.

Induction of high-protein mutants from rice variety Chianung 242 was attempted using γ radiation. Over two thousand M_2 plants were grown and preliminary analysis for protein content (on the basis of the Kjeldahl method) was carried out. Lines derived from irradiated seed had lower mean protein content than the parent variety but had a higher variation in protein content, so that selection of lines with higher protein in later generations seems likely. The distribution of protein within the rice grain was also studied by machine-polishing grain to eight different levels. Considerable differences in the extent of protein loss with polishing were noted among the five varieties studied. (auth)

2872 BREEDING FOR HIGH PROTEIN CONTENT AND QUALITY IN RICE BY NUCLEAR TECHNIQUES. Monyo, J. H. (Univ. of Dar es Salaam, Morogoro, Tanzania). pp 149-151 of Nuclear Techniques for Seed Protein Improvement. Vienna; International Atomic Energy Agency (1973).

From research coordination meeting on nuclear techniques for seed protein improvement; Neuherberg, F.R. Germany (26 Jun 1972). See STI/PUB-320; CONF-720694-.

The history of conventional plant breeding of rice in Tanzania is briefly traced. A mutation breeding program has now been started, aimed at improving protein content and quality in two local high-yielding rice varieties. Selection will also be made for other improvements, e.g., lodging resistance, non-shattering character, day neutrality, and fertilizer response. Treatment with fast neutrons and γ rays has already been effected. (auth)

2873 VARIATION IN CONTENT AND COMPOSITION OF PROTEIN IN WHEAT INDUCED BY MUTATION. Dumanovic, J. (Inst. for the Application of Nuclear Energy in Agriculture, Veterinary Medicine and Forestry, Zemun, Yugoslavia); Denic, M.; Jovanovic, C.; Ehrenberg, L. pp 153-161 of Nuclear Techniques for Seed Protein Improvement. Vienna; International Atomic Energy Agency (1973).

From research coordination meeting on nuclear techniques for seed protein improvement; Neuherberg, F.R. Germany (26 Jun 1972). See STI/PUB-320; CONF-720694-.

Some results from a current mutation breeding program in hexaploid wheat aimed at increased protein production and/or improved protein quality are summarized. The possibilities of inducing heritable variations in the content and composition of the grain protein of wheat by different mutagenic treatments are emphasized. The rather high heritable shift of the protein content in a positive direction is explained by the fact that previous selection for this character has not been made. It is estimated that by mutation breeding a fair opportunity exists not only to increase the protein level but also to improve the nutritional quality of the grain protein. The negative correlations of high protein content with total productivity and/or a better balance of essential amino acids (= better quality) will increase the demands on the amount of material to be analyzed, with the consequence that the screening procedures need to be more efficient in order to satisfy the stronger present criteria. (auth)

2874 INCREASE AND IMPROVEMENT OF PROTEIN CONTENT OF CEREALS AND LEGUMES IN CYPRUS. Hadjichristodoulou, A.; Della, A. (Agricultural Research Inst., Nicosia, Cyprus). pp 163-179 of Nuclear Techniques for Seed Protein Improvement. Vienna; International Atomic Energy Agency (1973).

From research coordination meeting on nuclear techniques for seed protein improvement; Neuherberg, F.R. Germany (26 Jun 1972). See STI/PUB-320; CONF-720694-.

The project was initiated on July 1, 1971. The growing season for cereals and most legumes in Cyprus is November to June; material sown in November–December 1971 was harvested in May–June 1972. The material grown during the last season was: (a) the M_3 generation of barley (varieties Athenais and Beecher) and durum wheat (Kyperounda) treated in 1969; (b) the M_1 generation of Athenais barley and Capeiti wheat treated in 1971; and (c) selections made in 1970–71 from local populations of wheat, barley, and common vetch. In Spring 1972 the protein-rich barley variety CI 3947 (Hiproly) and the Swedish lines Sv 71/668, Sv 71/670, and Sv 71/672 were crossed with the local fodder barley variety Athenais. Protein content, dye-binding capacity (DBC), and lysine index determinations were carried out on a number of wheat and barley varieties harvested in 1971 and on barley mutants harvested in May–June 1972. Protein content determinations by the Udy dye method (Y) were strongly correlated with determinations made by the Kjeldahl method (X). The correlation coefficient was equal to 0.96** and the regression line was $Y = -2.24 + 1.1 X$ based on 149 wheat samples. Similarly, regression analysis on protein determinations by the two methods on 100 samples of fodder barley produced a correlation coefficient $r = 0.99^{**}$ and on regression line $Y = -0.68 + 0.96 X$. The DBC was negatively correlated with protein content estimated by the Kjeldahl method, wheat $r = -0.79^{**}$, barley $r = -0.96^{**}$. Lysine index was positively correlated with DBC, but although the correlation coefficient was significantly different from zero, it was not very strong ($r = 0.25^{*}$). The protein content of barley C 13947 and Sv 71/668, used as parents in hybridization breeding programs, was 73% and 50% higher, respectively, than that of the local variety Athenais. The protein content of some M_3 mutants of the barley varieties Athenais and Beecher was up to 10% higher than that of the control. Screening for protein has not yet been completed. (auth)

2875 QUANTITATIVE AND QUALITATIVE SITUATION OF SEED PROTEINS IN MUTANTS AND RECOMBINANTS OF PISUM SATIVUM. Mueller, H.; Gottschalk, W. (Univ., Bonn). pp 235-253 of Nuclear Techniques for Seed Protein Improvement. Vienna; International Atomic Energy Agency (1973).

From research coordination meeting on nuclear techniques for seed protein improvement; Neuherberg, F.R. Germany (26 Jun 1972). See STI/PUB-320; CONF-720694-.

A group of radiation-induced pea mutants and recombinants was investigated for seed production and some other characters of economic interest such as stem length, seed size, flowering and ripening time, stem bifurcation, and fasciation. Protein content of the seeds, protein distribution within the different organs of the seeds, and protein patterns were analyzed. On the basis of all these criteria it was possible to calculate the protein yield of the respective genotypes as one of the most important characters for their nutritive value. It could be shown that two fasciated mutants and a fasciated recombinant seem very promising for utilization in pea breeding because of their high protein production. The increase of seed protein per plant of these genotypes varied between 20 and 70%, considering three subsequent generations. Moreover, one of the fasciated mutants showed a 33% increase of sugar content. The globulins, as the major fraction of the storage proteins, were electrophoretically analyzed. It was possible to separate this fraction into 3–6 distinct subfractions the concentration of which varies considerably in the different genotypes studied. (auth)

2876 EFFECTS OF GAMMA IRRADIATION OF SOYBEANS FOR MUTATION BREEDING. Smutkupt, S. (Chiengmai Univ., Thailand). pp 255-261 of Nuclear Techniques for Seed Protein Improvement. Vienna; International Atomic Energy Agency (1973).

From research coordination meeting on nuclear techniques for seed protein improvement; Neuherberg, F.R. Germany (26 Jun 1972). See STI/PUB-320; CONF-720694-.

In June 1970 two soybean varieties, Sansai, a local variety, and SJ2, an improved variety, were treated with γ rays from a cobalt source at the Institut für Strahlenbotanik, Hannover, Federal Republic of Germany. Five different doses, 5, 10, 15, 20, and 30 krad, were used. Subsequent germination of the treated seeds was carried out in greenhouse and field and the germination percentage of M_1 seedlings recorded. The M_1 seedling height was measured 20 days after planting. Frequency of spot-chlorosis appearing on first single leaves in M_1 seedlings was observed. It was found that no significant effect on seed germination or seedling height was caused by the γ-radiation doses applied (5 to 30 krad). The frequency of spot-chlorosis observed in M_1 seedlings did not correspond to the frequency of yellow seedlings in M_2 generation. The doses between 5 and 15 krad were most effective in producing mutants in SJ2 variety; in Sansai variety the effective dose was 15 krad. (auth)

2877 IMPROVEMENT OF PROTEIN CONTENT AND QUALITY IN GRAIN LEGUMES AND WHEAT BY MUTATION BREEDING. Bravo, A. (Universidad Catolica de Chile, Santiago). pp 263-264 of Nuclear Techniques for Seed Protein Improvement. Vienna; International Atomic Energy Agency (1973).

From research coordination meeting on nuclear techniques for seed protein improvement; Neuherberg, F.R. Germany (26 Jun 1972). See STI/PUB-320; CONF-720694-.

Mutation breeding was started in wheat, beans (Phaseolus), and chickpea (Cicer), all important sources of dietary protein in Chile. In wheat, the aim is to increase protein content, while in the legumes increase of methionine is sought. Gamma-irradiated seeds were planted in 1971. Second-generation plants will be grown in 1972. (auth)

2878 BREEDING FOR IMPROVED PROTEIN IN PULSES USING RADIATION-INDUCED MUTATIONS. Abo-Hegazi, A. M. (Atomic Energy Establishment, Cairo); Shoeb, Z. E.; Salama, F. M.; Hakam, M. pp 265-268 of Nuclear Techniques for Seed Protein Improvement. Vienna; International Atomic Energy Agency (1973).

From research coordination meeting on nuclear techniques for seed protein improvement; Neuherberg, F.R. Germany (26 Jun 1972). See STI/PUB-320; CONF-720694-.

Experiments on induced mutations have proved mutation breeding to be an effective tool for crop improvement. Pulses are a vitally important protein-rich food in developing countries; this work has been conducted in the hope of improving protein in the main legumes of Egypt. Materials of the program for improving pulses include the local varieties of Vicia faba, Lens esculenta, Trigonella foenum graecum, Ciser arietinum, and Lupinus termis. Seeds were irradiated with ^{60}Co γ-ray doses ranging from 500 to 10,000 rad. Crude protein was estimated in 20 of the mutants of V. faba that represented striking departures from the mother type and that were selected in a current program for improving pulse crops. Preliminary results are considered encouraging as regards protein content and other characteristics such as earliness, lodging resistance, and disease resistance. However, definite conclusive results cannot be reached at this early stage. (auth)

Radiation Effects on Animals

Refer also to abstract 3678.

Man

Refer also to abstracts 2839 and 4525.

2879 (CEA-CONF-2265) ACCIDENTAL CASE OF PROFESSIONAL RADIODERMATITIS. Le Guen, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1973. 10p. (In French). (CONF-730131-1). Dep. NTIS (U.S. Sales Only) $3.00.

From Colloque Franco-Anglais Sur Les Dermatoses Professionnelles; Paris, France (8 Jan 1973).

A case of accidental radiodermatitis due to an indium source is described. The development of the lesions observed is presented. The accident was reconstituted using a phantom man made of tissue-equivalent material and containing a human skeleton. The exposure conditions were determined such that the film carried by the phantom gave the same dose as that recorded by the chest dosimeter during the accident. Irradiation studies indicate that the accident, which at the beginning could have been classed as an acute localized irradiation, should be classed as a total heterogeneous irradiation with localized areas of particularly high exposure. The necessity of using depth dosimetry in the case of ordinary accidental radiodermatitis was demonstrated. (FR)

2880 (UCSF-10-P-2-211) LONG TERM EFFECTS OF THERAPEUTIC IRRADIATION ON THE LUNG. Phillips, T. L.; Margolis, L. W.; Wara, W. M. (California Univ., San Francisco (USA)). 1973. 14p. (CONF-731012-3). Dep. NTIS $3.00.

From thirteenth international congress of radiology; Madrid, Spain (15 Oct 1973).

Effects of radiation on the lung are of great importance in radiation therapy. The clinical syndrome is characterized by the onset of fever, cough, and dyspnea one to three months after completion of treatment. Progression to permanent fibrosis is noted in patients given higher doses. Histologically the changes are seen chiefly in the capillary bed of the lung with concurrent changes in the pulmonary epithelium. The result is a depletion of the number of alveolar capillaries, a thickening of their walls, and an overall reduction of the ability of the lung to exchange air. The time-dose relationships in radiation pneumonitis both in experimental animals and in patients are exemplified by a rather small effect of time. Calculations based on time-dose formulas from the laboratory yield useful guidelines as to the radiation tolerance of the lung which have withstood the test of clinical experience. (auth)

2881 IMPLICATIONS OF COMMISSION RECOMMENDATIONS THAT DOSES BE KEPT AS LOW AS READILY ACHIEVABLE. A Report of ICRP Committee 4 Adopted by the Commission in April 1973. Oxford; Pergamon Press (1973). 23p. (ICRP-22).

The assumption is made that no level of exposure to radiation can be considered to be without risk, and conditions should be such that the detriment resulting from exposures to radiation can be made less important than the benefits to individuals and to society from activities that result in the exposures; and any further reductions in detriment become less important than the effort that would be required to accomplish such reductions. After a discussion of the basic principles of dose limitation and of the practical application of the ICRP recommendations, it was concluded that: the system of dose limitation recommended by the Commission includes, but is not restricted to, the quantitative Maximum Permissible Doses and Dose Limits. As any exposure may involve some degree of risk, and thus some detriment, the comprehensive system of dose limitation is aimed at the following principal objectives: to secure compliance with the dose limits; to avoid the use of unnecessary sources of exposure; to provide for operational control of specific procedures, both individually and in combination, so that the resulting doses are as low as is reasonably achievable, economic and social considerations being taken into account; and to provide a more general framework to ensure that these doses are justifiable in terms of benefits that would not otherwise have been received. (UK)

2882 VOPROSY RADIOBIOLOGII I BIOLOGICHESKOGO DEISTVIYA TSITOSTATICHESKIKH PREPARATOV. (Problems in Radiobiology and Biological Action of Cytostatic Preparations). Gol'dberg, E. D. (ed.). Tomsk, USSR; Izdatel'stvo Tomskogo Universiteta (1969). 141p.

Separate abstracts were prepared for 13 of the 32 papers presented in this publication. The other papers discuss the biological action of cytostatic preparations. (ERB)

For abstracts of individual papers see: 2883, 2884, 2914–2923, and 4360.

2883 SIZES OF GRANULOCYTES IN HEALTHY HUMANS AND IN LEUCOPENIA DUE TO ACTION OF IONIZING RADIATION AND BENZENE. Tolcheva, E. I. pp 44-47 of Voprosy Radiobiologii i Biologicheskogo Deistviya Tsitostaticheskikh Preparatov. Gol'dberg, E. D. (ed.). Tomsk, USSR; Izdatel'stvo Tomskogo Universiteta (1969). (In Russian).

In persons chronically exposed to ionizing radiation, the leukocyte count dropped to 3000 to 4200 per cubic mm and in those chronically poisoned with benzene, 2000 to 3000. In the irradiated patients, all granulocytes increased in size, with a decrease in the number of microforms and increase in the number of macroforms. In the benzene-poisoned patients, only the myelocytes were larger. In the first group the myelocytes macroforms were 29.5% and the micro, 12.6%. In the second group, the values were 28.7% and 13.4%, respectively. In the leukopenia, apparently, the number of metamyelocytes increases, being formed from macro and meso forms. This results in an increase in the size of the cells formed. (TTT)

2884 OSMOTIC RESISTANCE OF LEUCOCYTES IN LEUCOCYTES IN LEUCOPENIA DUE TO PROFESSIONAL FACTORS. Gribova, I. A. pp 48-51 of Voprosy Radiobiologii i Biologicheskogo Deistviya Tsitostaticheskikh Preparatov. Gol'dberg, E. D. (ed.). Tomsk, USSR; Izdatel'stvo Tomskogo Universiteta (1969). (In Russian).

Leukocyte resistance was studied in 167 persons with moderate leucopenia due to exposure to benzene or ionizing radiation. Despite the low osmotic resistance of the neutrophils, there was no increase in destruction in the fibro-vascular bed. Possibly the cells are destroyed in the tissues, the vessels of the lung, or on the mucous membrane surfaces. (TTT)

2885 MECHANISMS OF CHANGE IN HISTAMINE CONTENT DUE TO RADIOPROTECTIVE AGENTS. Goncharenko, E. N.; Briedis, I. (Moscow State Univ.). Biol. Nauki; No. 10, 48-50 (1971). (In Russian).

Increase of the histamine content after introduction of animal radioprophylactic materials and the production of hypoxide hypoxy is related to the change in the activity of the ferments participating in the exchange of this amine. The data obtained made it possible to assume that the increase of the quantity of histamine under conditions of radioprophylaxis is related to the newly formed histamine because of the amplification of the process of decarboxylation and as a result of the inhibition of the process of destruction of this biogenic diaminoxydase amine. (tr-auth)

2886 IMPORTANCE OF CELL-PHYSIOLOGICAL AND BIOCHEMICAL EVENTS IN CHEMICAL RADIATION PROTECTION. Hernadi, F. Magy. Radiol.; 25: No. 4, 236-242(Aug 1973). (In Hungarian).

The actions of the chemical radiation protection may be classified into two groups: physico-(radio)-chemical and metabolic radiation protective effect mechanisms. As physico-chemical radiation protection is understood: development of hypoxia and anoxia, development of mixed disulfide, chemical modification of the DNA target, and H-transmission. As metabolic radiation protective effects (biochemical shock, release or activation of endogenous radiation protective substances, fixation of metal ions, establishment of more resistant cell-physiological status, promotion of the development of restitutive processes on cellular level or on the level of cell populations) are understood: increase of the radiation resistance due to physiological and biochemical changes elicited in the biological objects by means of radiation protective influences or processes. (auth)

2887 EXPERIENCES WITH THE ^{125}I AND COMBINED ^{125}I + ^{131}I RADIOIODINE THERAPY OF HYPERTHYREOSIS. Konrady, A.; Tahy, A.; Banhidi, L.; Policzer, M. (VIII. ker. Tanacs VB Balassa Janos Korhaza, Budapest). Izotoptechnika; 16: No. 7-8, 396-400(1973). (In Hungarian).

By ^{125}I a lowering of function could be reached without permanently damaging the thyroid tissue. Combined with ^{131}I, the ^{125}I produces an early antithyreoid effect in the treatment of medium and acute hyperthyreosis, and is recommended when the previous ^{131}I-therapy did not give satisfactory results. (auth)

2888 DOSE MEASUREMENT IN THE RADIATION TREATMENT OF TUMORS (BASED ON THE PAPER OF B. WALDESHOG AND I. CLASSEN). Szy, D. Magy. Radiol.; 25: No. 4, 243-246 (Aug 1973). (In Hungarian).

In the radiation therapy of tumors, the result of the treatment is determined by the dose given to the tumor. At the measurement of the dose, greater error than ± 5% should not occur, especially in treatments performed with ^{60}Co-bomb apparatus. In the determination of the dose, even greater errors than 100% may occur. In nearly 50% of the therapeutic institutes comprised in the author's examinations, the therapeutic doses were given with greater error than the acceptable ± 5%. Similar examinations would be suitable and useful also in Hungary. (auth)

2889 DIFFERENTIAL DIAGNOSIS OF RADIATION AND NONSPECIFIC PNEUMONIA. Shapiro, I. B. (Central Research Inst. of Roentgeno-Radiology, Leningrad). Med. Radiol.; 18: No. 11, 14-23(Nov 1973). (In Russian).

Two hundred and six patients who had undergone radiation treatment for tumor of the esophagus were studied. Of this number, in 76 patients radiation pneumonia developed and 51 patients suffered from acute chronic nonspecific pneumonia. In comparison of the observed clinico-roentgenological data, some differential-diagnostical signs were found that made it possible to determine correctly the character of changes occurring in the lungs in the course of radiation treatment and after it. (auth)

2890 MAIN SOURCES OF ERRORS IN DIAGNOSIS OF CHRONIC RADIATION SICKNESS. Soldatova, V. A. Med. Radiol.; 18: No. 11, 30-35(Nov 1973). (In Russian).

With the aim of finding out the main sources of errors in the diagnosis of chronic radiation sickness, the author analyzed a total of 500 cases of this sickness in roentgenologists and radiologists sent to the clinic to be examined according to occupational indications. It was shown that the main source of errors when interpreting the observed deviations as occupational was underestimation of etiological significance of functional and organic diseases of the nervous system, endocrinevascular dystonia and also such diseases as hypochromic anemia and chronic infection. The majority of diagnostic errors is explained by insufficient knowledge of the main regularity of forming the picture of chronic radiation sickness and by the absence of the necessary differential diagnosis with general somatic diseases. (auth)

2891 SEMICONDUCTOR DETECTORS USED IN β-DOSIMETRY OF THE SKIN. Andreev, P. N.; Kozlov, Yu. N.; Filov, R. A. (Kharkov Scientific-Research Inst. of Medical Radiology). Med. Radiol.; 18: No. 11, 59-62(Nov 1973). (In Russian).

When considering the effect of ionizing radiation on the skin some authors assume that the most sensitive part is the basal layer of the skin. From various possible methods of determining the dose, the authors studied the possibility of applying surface-barrier semiconductor detectors for this purpose. It was shown that in case of a proper choice of a discrimination threshold, energy dependence for such detectors was not less than 30 per cent. The sensitivity of a detector with an area of 20 mm^2 was 5 pulse/min per mrad/hr. (auth)

2892 INFLUENCE OF WEDGE-LIKE FILTERS ON DOSE DISTRIBUTION IN REMOTE GAMMA IRRADIATION WITH A MOBILE BEAM. Zevrieva, I. F.; Dzholdybaev, M. S. (Scientific-Research Inst. of Oncology and Radiology, Alma Ata, USSR). Med. Radiol.; 18: No. 11, 54-59(Nov 1973). (In Russian).

Methods of mobile segmental irradiation through wedge-like filters are described. A formula is proposed that showed interrelation between the angle of the wedge and the main parameters of irradiation. An experimental investigation was made of the influence of wedge-like filters on the main characteristics of the dose field. A considerable increase of the efficacy factor was established when using wedge-like filters in comparison with mobile irradiation without filters. The method described could be recommended for irradiation of extensive tumors with the use of small angles of swinging with the wedge. (auth)

2893 CALCULATION OF FOCAL DOSE IN ECCENTRIC ROTARY IRRADIATION. Belov, S. A.; Kaveshnikova, S. V.; Ratner, T. G. Med. Radiol.; 18: No. 11, 51-54(Nov 1973). (In Russian).

A method of calculation of the dose in the focus in eccentric rotary irradiation is proposed. It was shown that the errors made in calculation were not higher than 4%. (auth)

2894 INDUCTION OF LEUKEMIA BY ^{131}I TREATMENT OF THYROID CARCINOMA. Brincker, H.; Hansen, H. S.; Andersen, A. P. (Radiumstationen, Odense, Denmark). Brit. J. Cancer; 28: No. 3, 232-237(Sep 1973).

The records of 194 patients with thyroid carcinoma treated with ^{131}I, representing all cases thus treated in Denmark from 1948 to 1972, are reviewed. Two cases of myeloid leukemia were found compared with 0.097 expected cases of non-lymphocytic leukemia ($0.05 > P > 0.01$). In five series of ^{131}I treated thyroid carcinomata, 10 cases of myeloid leukemia occurred in a total of 487 patients, corresponding to a frequency of leukemia of about 2%. These findings appear to show that ^{131}I treatment of thyroid carcinoma is associated with a certain risk of development of leukemia. This risk must be considered when treatment of localized thyroid carcinoma is planned. (auth)

2895 POSTIRRADIATION BOWEL DAMAGE. Berg, D. (Angan Memorial Hospital, Papua, New Guinea). Med. J. Aust.; 2: No. 10, 492-495(8 Sep 1973).

The case history of a patient who developed late postirradiation bowel changes and complications is presented. The pathology, clinical presentation, incidence, and surgical management of postirradiation bowel damage are reviewed. The high mortality that follows surgical intervention is noted, and the importance of early diagnosis stressed. Some basic principles on which to plan surgical treatment are put forward. (auth)

2896 PRENATAL IRRADIATION, POSSIBLE ETIOLOGICAL FACTOR IN EPILEPSY. Geets, W. (Clinique Sainte-Elisabeth, Brussels). Acta Neurol. Belg.; 72: 330-337(1972). (In French).

Twenty four cases of epilepsy in a group of 28 children aged 1 month to 16 yrs, in whom antecedents were negative except that the mother had undergone an abdominal radiography during pregnancy were observed. In seven cases a mild mental retardation was noted. Generalized seizures were first observed between the age of 1 month and 4.5 yrs, focal attacks between the age of 7 and 12.5 yrs. EEG recordings at rest show discharges of generalized or focal slow waves in eight cases and a reduced acceleration of the cerebral rhythm between 3 and 7 yrs, in seven cases. These clinical observations confirm some experimental data but a statistical analysis on a larger scale is necessary. (auth)

2897 STUDY ON THE PROTECTION OF WORKERS AGAINST IONIZING RADIATIONS IN BELGIUM. Hublet, P. (Univ., Brussels). J. Belge Radiol.; 56: No. 2, 184-189(1973). (In French).

Regulations, based on the standards of EURATOM, for protection of the population and workers against ionizing radiations are discussed. Radiation protection is based on the idea of the controlled zone which is a designated space where exposed personnel may receive a radiation dose of more than 1.5 rem/yr. Periodic medical examinations and personnel dosimetry are recommended. The annual permissible dose is fixed at 5 rem/yr of total radiation for workers aged 18 or over. A table is presented of types of personnel in controlled zones who should carry dosimeters. Tables are presented to show the distribution of workers exposed to ionizing radiation in health institutions, industrial and commercial enterprises, and research and teaching, and dose distributions among these workers from 1965 to 1971. It is concluded that the radiation risk to workers in Belgium is maintained by present laws within very acceptable limits. (HLW)

2898 URINARY BLADDER FUNCTION IN IRRADIATED UTERINE CARCINOMA. Functional Behavior of the Urinary Bladder During Therapy with Ionizing Radiation. Kuemper, H. J. (Univ., Munich). Fortschr. Med.; 91: No. 14, 627-632 (17 May 1973). (In German).

Radiotherapy was administered to 288 patients suffering from uterine carcinoma. Before and after irradiation, the urinary bladder was measured by cysto-tonometry. Early radiation-induced reactions consisted of increased bladder tonus and decreased bladder capacity. The general reduction in bladder function during radiotherapy returned to almost normal values within one year post-radiation. Cysto-tonometry proved to be a useful tool for monitoring the urinary bladder after radiation treatment. (HBG)

2899 SEARCH FOR CHEMICAL COMPOUNDS WITH POTENTIAL RADIOPROTECTIVE EFFECTS (REVIEW). Vladimirov, V. G.; Kostyukovskii, Ya. L.; Slavachevskaya, N. M.; Parfenov, A. I. Farmakol. Toksikol.; 35: No. 6, 747-753 (1972). (In Russian).

Materials leading to the conclusion that in recent years very wide chemical and radiobiological studies were carried out with the purpose of searching for new effective radioprotective substances are reported. The search for new radioprotective compounds was done principally in the class of sulfur-nitrogen containing substances although work on the approval on the radioprotective activity of representatives of other groups of chemical compounds was expanded. New trends are the synthesis and description of the antiradiation activity of substances with complicated structure (principally the introduction of long-chained radicals in the molecule). (tr-auth)

2900 ULTRASOUND AND CHROMOSOME ABERRATIONS. Brock, R. D. (Commonwealth Scientific and Industrial Research Organization, Canberra); Peacock, W. J.; Geard, C. R.; Kossoff, G.; Robinson, D. E. Med. J. Aust.; 2: No. 11, 533-536(15 Sep 1973).

Human and marsupial whole blood and blood-medium mixtures were irradiated with various doses of 2.25 MHz ultrasound and gamma rays. Doses of ultrasonic irradiation orders of magnitude higher than those used for diagnostic studies produced very few chromosome aberrations. A large proportion of the chromosome aberrations observed were gaps, rather than true breaks. If gaps are excluded from the analysis, our data show no significant induction of chromosome damage by ultrasound. High doses of ultrasound did, however, cause mitotic inhibition. Although very little chromosome damage was observed there is still the possibility of induced genetic damage that is undetectable at a cytological level; consideration of this possibility should be given in clinical applications. (auth)

2901 RENAL FUNCTION IN PATIENTS WITH CANCER OF THE URINARY BLADDER PRIOR TO AND AFTER RADIATION TREATMENT. Kholin, V. V.; Strashinin, A. I.; Libson, I. L. (State Postgraduate Medical Inst., Leningrad). Vop. Onkol.; 19: No. 9, 28-34(1973). (In Russian).

By means of radioisotope renography the renal function was studied in 81 patients with vesical cancer, stage III–IV, before and after radiation therapy. Prior to radiation therapy renal disturbances of a different degree of pronouncement were noted in 74% of patients, these were considered to be a contraindication to the use radiation therapy in eight cases. The radiation treatment resulted in a considerable improvement of the renal function in 22% of patients, no changes were noted in 46%, and deterioration in 32%. Some possible causes of alterations in the renal function in patients with the vesical cancer before and after the radiation treatment are analyzed. A conclusion is drawn on a high efficacy of radioisotope renography in investigation of the renal function in patients with cancer of the urinary bladder in all stages of their investigation and treatment. (auth)

2902 SCIENTIFIC ACTIVITIES OF THE DEPARTMENT OF SKIN AND VENEREAL DISEASES OF THE KHARKOV MEDICAL INSTITUTE DURING 1966–1971. Zadorozhnyi, B. Vestn. Dermatol. Venerol.; 47: 46-51(Apr 1973). (In Russian).

Investigations include radiation lesions of the skin, some aspects of the pathogenesis of psoriasis, as well as other important problems of dermatology and venereology. Data of numerous studies are presented on morphological lesions, on disorders in the physiological functions and metabolic processes in the skin and internal organs under the effect of ionizing radiation and under a combined effect of radiation and temperature. In patients with psoriasis, the concentration of free radicals was studied by the method of electronic paramagnetic resonance, as well as protein metabolism, the kinine system, the enzymatic metabolism in the skin and blood serum, the functional status of the liver and the kidneys. Materials are presented on the study of dermatitis and eczema in workers of the machine-building industry with reference to the social-hygienic and economic factors. New therapeutic ointment bases (aminobenthonites) were studied. Original studies are dedicated to important problems of venereology. (auth)

2903 HAZARDS IN RADIOLOGICAL PROCEDURES. Cantwell, D. F. (St. Vincent's Hospital, Dublin). Irish J. Med. Sci.; 142: No. 2, 66-78(Mar 1973).

A review of complications associated with diagnostic radiological investigations is presented. Some topics discussed are: reduction of radiation dose due to technical improvements in radiodiagnosis; hazards of radiodiagnosis and radiotherapy during pregnancy; factors responsible for reactions to contrast media; side effects of the lymphangiogram and the bronchogram; side effects of retroperitoneal pneumography, myelography, pyelography, cholecystography, arteriography, venography, and cardiography; and cardiovascular investigations. (HLW)

2904 ERSTE HILFE BEI STRAHLENUNFAELLEN. (First Aid in Radiation Accidents). Stuttgart; A. W. Gentner Verlag (1972). 139p.

Following an introduction to the physical and biological principles relating to the effect of radiation on man, individual sections by different authors are devoted to the following subjects: physical determination of individual doses; medical measures to be taken in the event of irradiation of a part of the body or the whole of the body; skin contamination and decontamination; procedure in the event of contaminated wounds; determining the dose received following accidental absorption of radionuclides; first aid. These various contributions deal with dosimetry equipment and techniques; the clinical course of radiation, contamination and incorporation accidents; diagnosis and prognosis; emergency measures and treatment. (Occup. Saf. Health Abstr.)

2905 PROBLEMS IN LEUKEMIA ETIOLOGY. Gunz, F. W. Haematol. Bluttransfus.; 9: 48-57(1970).

Studies on the genetics of murine and human leukemia revealed striking differences between the two types. The importance of genetic factors in human leukemia was shown by studies on twins, mongols, and other high-incidence groups. The relation of high doses of radiation to leukemogenic activity is pointed out. Analyses of data on leukemia in children indicate a multifactorial etiology. Evidence exists for the presence of many factors in man that are etiologically relevant in the mouse. Peak incidences of leukemia in man in relation to age are discussed. Of all types of leukemia, chronic lymphocytic leukemia is not caused by radiation; the genetic background of this type is unusually evident. (HLW)

2906 OHRANA TRUDA, PROTIVOPOZARNAYA PROFILAKTIKA, AEROLOGIYA KAR'EROV I PRIISKOV. (Occupational Safety and Health, Fire Prevention, and Ventilation in Mining and Quarrying). Savenko, S. K.; Osmyanskii, I. B.; Kurov, I. F. Moscow; Izdatelstvo Nedra (1972). 352p. 1.03 Roubles.

This handbook is designed for Soviet teaching establishments. Individual sections are devoted to: occupational safety and health regulations and organisation; occupational health in opencast mining (control of harmful gases and dusts, improvement of microclimate, protection against ionising radiation, noise and vibration control, lighting, sanitary and medical-care installations); accident prevention in opencast mining (safe working procedures, machinery guarding, safe use of transport, electrical safety, shot firing and blasting, protection against inrushes of water and rock falls); safety and health in underground workings (atmospheric monitoring, dust control, ventilation, accident prevention); fire prevention. (Occup. Saf. Health Abstr.)

2907 HAZARDS OF THE FIRST NINE MONTHS: AN EPIDEMIOLOGIST'S NIGHTMARE. Doll, R. (Oxford Univ.). J. Irish Med. Ass.; 66: No. 5, 117-126(10 Mar 1973).

A review is presented of the hazards to which the embryo or fetus is exposed in utero. Emphasis is placed on factors that produce delay in development, congenital malformations, and malignant disease later in life. With regard to ionizing radiations it was found that all studies indicated that the increase in cancer risk associated with exposure to x rays in utero was 50 to 100%. Japanese data indicated a lack of increased mortality from cancer among the children who were irradiated in utero by the atomic bomb explosions in Japan. However, the production of congenital malformations by ionizing radiations was demonstrated by the high incidence of microcephaly among infants irradiated in utero by the atomic bomb explosions in Japan. In utero exposure to the following hazards are also reviewed: drugs, viral infections, smoking, and dietary deficiencies. (HLW)

2908 INTERACTING CELL POPULATIONS AFFECTING GRANULOPOIETIC COLONY FORMATION BY NORMAL AND LEUKEMIC HUMAN MARROW CELLS. Messner, H. A.; Till, J. E.; McCulloch, E. A. (Univ. of Toronto). Blood; 42: No. 5, 701-710(Nov 1973).

Marrow from 28 nonleukemic individuals was separated by adherence to glass or plastic into nonadherent (NA) and adherent populations. The NA populations were found to be more dependent for colony formation in culture on added colony-stimulating activity (CSA) than unseparated marrow suspensions, and therefore proved useful for CSA assays. Quantitative reconstitution procedures were used to assay CSA-producing cells. Either increasing numbers of irradiated unseparated marrow, or adherent cells derived from varying numbers of marrow cells, were used to restore colony-forming efficiency to NA populations. Assay procedures for CSA-producing cells were applied to four patients with acute leukemia prior to treatment. In all four instances, a defect in CSA-producing cells was demonstrated. (auth)

2909 HEALTH EFFECTS OF ELECTRICITY GENERATION FROM COAL, OIL, AND NUCLEAR FUEL. Lave, L. B.; (Carnegie Mellon Univ., Pittsburgh); Freeburg, L. C. Nucl. Safety; 14: No. 5, 409-428(1973).

Occupational- and public-health effects of generating electricity from coal, uranium, and oil are compared, with particular attention given to accident and chronic-disease rates for fuel extraction and airborne emissions from power and reprocessing plants. It is concluded that uranium offers less of a health hazard as a fuel than coal. The analysis is based on current operating practice; however, advances in technology can be expected to reduce both the occupational- and public-health risks from these fuels. (auth)

2910 GRAVES' OPHTHALMOPATHY FOLLOWING EXTERNAL NECK IRRADIATION FOR NONTHYROIDAL NEOPLASTIC DISEASE. Wasnich, R. D.; Grumet, F. C.; Payne, R. O.; Kriss, J. P. (Stanford Univ., CA). J. Clin. Endocrinol. Metab.; 37: No. 5, 703-713(Nov 1973).

Seven patients have been observed who developed Graves' ophthalmopathy 18 to 84 months following x-irradiation to the neck for nonthyroidal neoplastic disease. In none was there evidence of thyroid disease prior to neck irradiation. The primary neoplasms included Hodgkin's disease and carcinomas of the nasopharynx, breast, and larynx. Most patients received unilateral or asymmetrical thyroid gland irradiation in doses under 5000 rads. Thyroid scanning or scintigraphy demonstrated residual functioning thyroid tissue in all the patients. The diagnosis of Graves' disease was established by clinical and laboratory parameters, including serum long-acting thyroid stimulator and serum antithyroid antibodies. Four patients developed hyperthyroidism and ophthalmopathy concurrently, while 3 developed opthalmopathy alone. HL-A typing for histocompatibility antigens revealed that none of 5 Caucasian patients tested was type HL-A8, an antigen present in about 50% of Caucasian patients who apparently develop Graves' disease spontaneously. These results suggest that thyroidal injury may be an important factor in the etiology of radiation-associated Graves' disease and that the patients herein reported may be genetically different from the latter group. (auth)

2911 SERUM THYROTROPIN LEVEL AND GOITER IN RELATION TO CHILDHOOD EXPOSURE TO ATOMIC RADIATION. Parker, L. N.; Belsky, J. L.; Mandai, T.; Blot, W. J.; Kawate, R. (Atomic Bomb Casualty Commission, Hiroshima). J. Clin. Endocrinol. Metab.; 37: No. 5, 797-804(Nov 1973).

Thyroid enlargement was found to be significantly increased among women exposed 27 yr previously to high doses of atomic radiation during childhood. Although goiters with nodules were relatively few, those also tended to occur in exposed women. Levels of serum thyrotropin were not correlated with the prevalence of goiter, nor were they related to atomic bomb exposure. Small but significantly increased levels were found in women, as compared with men. Atomic bomb survivors appear to have experienced thyroid gland injury that underwent functional recovery, although at the expense of glandular hyperplasia in those exposed to high doses of atomic radiation. (auth)

Vertebrates

Refer also to abstracts 2833, 2835, and 2949.

2912 (BNL-18319) CULTURE OF NORMAL AND LEUKEMIC CELLS IN DIFFUSION CHAMBERS. Cronkite, E. P.; Carsten, A. L.; Chikkappa, G.; Laissue, J. A.; Oehl, S. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 27p. Dep. NTIS $3.50.

Normal murine, caprine, and human bone marrow and peripheral blood cells can be grown in diffusion chambers. The irradiated host provides a stimulus to erythrocytic and granulocytic growth over what is seen in the DC's implanted in the nonirradiated host. The stimulus is most likely humoral and affects erythropoiesis, granulopoiesis, and megakaryocytopoiesis. It is suggested but not proved that the stimulus for erythropoiesis is an increased level of plasma erythropoietin. It is tempting to suggest that CSF and thrombopoietin are responsible for the stimulation of the other cell lines. Growth of normal human cells in irradiated mice shows a marked reduction of the transit time from the myelocyte to the segmented neutrophils. Growth does not follow steady conditions in terms of rates and transit times. Since all cells produced are retained in the DC's after the time they would normally be extruded into the blood, a nonsteady state system exists. Senescent death of non-proliferating cells occurs. Human leukemic and multiple myeloma cells grow in DC's as do blood cells from patients with myelofibrosis and myeloid metaplasia. Data are insufficient to characterize aberrations in growth. Pilot studies show that human eosinophils will grow, proliferate and mature. (auth)

2913 (UCSF-10-P-2-210) COMPARISON OF R.B.E. VALUES OF 15 MeV NEUTRONS FOR DAMAGE TO AN EXPERIMENTAL TUMOR AND SOME NORMAL TISSUES. Phillips, T. L.; Barschall, H. H.; Goldberg, E.; Fu, K.; Rowe, J. (California Univ., San Francisco (USA)). 1973. 20p. (CONF-731030-2). Dep. NTIS $3.00.

From second meeting on fundamental and practical aspects of the application of fast neutrons in clinical radiotherapy; The Hague, Netherlands (3 Oct 1973).

A high-intensity 15-MeV D–T neutron generator yielding up to 4.7×10^{12} neutrons per second was used to measure the biologic effect of neutrons in the EMT6 tumor, bone marrow, esophagus, and lung of the mouse. The RBE and OER values for the tumor are relatively close to those previously reported for the R_1 rabdomyosarcoma in the rat. The RBE values for the tumor range from 6.3 at 50% survival of hypoxic cells downward as a function of dose. The OER for neutrons was 1.8. The RBE for mouse bone marrow CFU's was 1.6. For the esophageal lethality the RBE was 4 and for pulmonary lethality 2.2. The results confirm the relative consistency of rodent tumors in response to neutrons and add further evidence on the wide range of RBE's to be expected in normal tissues. (auth)

2914 FUNCTIONAL CHARACTERISTICS AND CONSIDERATIONS OF THE MECHANISM OF GIANT NEUTROPHILIC LEUCOCYTE FORMATION IN ACUTE AND CRITICAL RADIATION SICKNESS. Gol'dberg, E. D. pp 3-7 of Voprosy Radiobiologii i Biologicheskogo Deistviya Tsitostaticheskikh Preparatov. Gol'dberg, E. D. (ed.). Tomsk, USSR; Izdatel'stvo Tomskogo Universiteta (1969). (In Russian).

2915 ROLE OF DIRECT AND INDIRECT ACTION OF IONIZING RADIATION IN THE FORMATION OF GIANT NEUTROPHILIC LEUCOCYTES. Gol'dberg, E. D.; Lapina, G. N. Karpova, G. V. pp 8-11 of Voprosy Radiobiologii i Biologicheskogo Deistviya Tsitostaticheskikh Preparatov. Gol'dberg, E. D. (ed.). Tomsk, USSR; Izdatel'stvo Tomskogo Universiteta (1969). (In Russian).

Guinea pigs whose posterior extremities were shielded during x irradiation (4000 rads) lived 6 days after the irradiation compared to a 4-day life of animals similarly irradiated but with no shielding. In the partially shielded animals, leukocyte depression was less on the second day but the same on the third day as in the totally irradiated group. The partially shielded animals showed fewer giant neutrophils. (TTT)

2916 HEMATOLOGIC NATURE OF CRITICAL FORMS OF RADIATION SICKNESS. Vorob'eva, M. G.; Golubev, I. V. pp 12-15 of Voprosy Radiobiologii i Biologicheskogo Deistviya Tsitostaticheskikh Preparatov. Gol'dberg, E. D. (ed.). Tomsk, USSR; Izdatel'stvo Tomskogo Universiteta (1969). (In Russian).

Experiments on guinea pigs showed that in critical radiation sickness caused by betatron irradiation there is considerable damage to peripheral blood, including development of progressive leucopenia. In the bone marrow, neutrophil formation is accelerated, many of the neutrophils having a segmented nucleus low in polysaccharides. Necrobiotic processes and megakaryocyte growth were observed along with bone marrow lymphocytes, eosinophils, and basophils. In many normoblasts, chromatolysis and pyknosis were seen and in their cytoplasm and in young forms of neutrophils the basophilia due to RNA was lost. The results indicate that a radiation dose as high as 15,000 rads eliminates the capability of conversion to giant hemohistoblasts and further differentiated forms. (TTT)

2917 LUMINESCENT-CYTOLOGICAL CHANGES IN BONE MARROW IN CRITICAL FORMS OF RADIATION SICKNESS DUE TO 25-MeV HIGH-INTENSITY BETATRON IRRADIATION. Kolpakov, V. A.; Vorob'eva, M. G. pp 16-19 of Voprosy Radiobiologii i Biologicheskogo Deistviya Tsitostaticheskikh Preparatov. Gol'dberg, E. D. (ed.). Tomsk, USSR; Izdatel'stvo Tomskogo Universiteta (1969). (In Russian).

In guinea pigs, immediately after 10,000 and 15,000 rads irradiation, bone marrow erythroblasts and lymphocytes showed intense green luminescence. The cytoplasm of myelokaryocytes showed coagulation. Segmented-nucleus neutrophils began to increase after 3 hr, and rod-shaped nuclei and slightly segmented forms, 18 to 20 μ in size, were seen. Ten hours after the larger dose and 15 to 17 hr after the smaller, many myeloid elements were found. Occasionally, in the cytoplasm of poorly differentiated cells were found yellow-green and orange circular formations that showed intense light refraction and high resistance to stimulating light. (TTT)

2918 PHAGOCYTIC ACTIVITY OF LEUCOCYTES IN ACUTE RADIATION SICKNESS DUE TO X IRRADIATION AND 25-MeV BETATRON IRRADIATION. Kochetkov, Yu. S., Mikhailova, T. N.; Zinger, G. V.; Shternberg, I. B. pp 20-23 of Voprosy Radiobiologii i Biologicheskogo Deistviya Tsitostaticheskikh Preparatov. Gol'dberg, E. D. (ed.). Tomsk, USSR; Izdatel'stvo Tomskogo Universiteta (1969). (In Russian).

In experiments on white mice, the subject radiations caused short-term stimulation of the phagocytic activity of leucocytes, followed by a depression. Absorption by phagocytes was decreased by 400 rads of x radiation but increased by betatron radiation. With 1000 rads the depression occurred without the stimulation. The observed effects are explained by the stimulating effect of low doses, stimulation followed by depression due to medium doses, and damage to one or more physiological mechanisms by high doses. The observed changes fit the concept of the action of physical factors on immunological reactions of an organism. (TTT)

2919 MORPHOLOGY OF THE NERVE APPARATUS OF THE SKIN IN GUINEA PIGS IN ACUTE RADIATION SICKNESS DUE TO BETATRON BREMSSTRAHLUNG WITH 30-MeV LIMITING ENERGY. Frolov, V. N. pp 24-26 of Voprosy Radiobiologii i Biologicheskogo Deistviya Tsitostaticheskikh Preparatov. Gol'dberg, E. D. (ed.). Tomsk, USSR; Izdatel'stvo Tomskogo Universiteta (1969). (In Russian).

Experimental data showed radioinduced (450 and 900 rads) morphological displacements. Two-phase changes occurred in the nerve apparatus: First, an increase in twisting of the fibers, strengthening or weakening their impregnation, and formation of varicose thickenings. The second phase, destruction, followed the first phase. (tr-auth)

2920 MUCOPOLYSACCHARIDES OF REGENERATING BONE IN ACUTE RADIATION SICKNESS. Gendler, E. M. pp 27-29 of Voprosy Radiobiologii i Biologicheskogo Deistviya Tsitostaticheskikh Preparatov. Gol'dberg, E. D. (ed.). Tomsk, USSR; Izdatel'stvo Tomskogo Universiteta (1969). (In Russian).

In rabbits, the first few days after an x-radiation dose of 450 rads, the regenerating bone contained acid mucopolysaccharides, but as the regeneration progressed, the acid products gradually changed to neutral. (tr-auth)

2921 MORPHOLOGY OF THE NERVE SUPPLY OF THE DIGESTIVE TRACK IN RADIATION SICKNESS AND IN GUINEA PIGS SUBJECTED TO THERAPY WITH DEOXYRIBONUCLEIC ACIDS. Ryzhov, A. I.; Frumkis, E. M.; Berdyshev, G. D. pp 30-33 of Voprosy Radiobiologii i Biologicheskogo Deistviya Tsitostaticheskikh Preparatov. Gol'dberg, E. D. (ed.). Tomsk, USSR; Izdatel'stvo Tomskogo Universiteta (1969). (In Russian).

In guinea pigs given a single dose of 900 rads of x radiation, parenterally administered DNA had a definite therapeutic effect, as indicated by histological and chemical tests. (TTT)

2922 RELATION OF CELLULAR AND HUMORAL FACTORS OF PROTECTION IN EXPERIMENTAL LISTERIOSIS IN IRRADIATED MICE. Zinger, G. V. pp 34-38 of Voprosy Radiobiologii i Biologicheskogo Deistviya Tsitostaticheskikh Preparatov. Gol'dberg, E. D. (ed.). Tomsk, USSR; Izdatel'stvo Tomskogo Universiteta (1969). (In Russian).

Mice were x-irradiated with 200 rads and infected with Listeria. Irradiation intensified the infection compared with the controls. The leukocyte count in the peripheral blood was lower, phagocytosis was depressed, and there was a drop in the antibody-forming cells in the spleen in the irradiated mice. (TTT)

2923 MORPHOLOGICAL CHANGES IN THE VISUAL ORGANS OF GUINEA PIGS RESULTING FROM CHRONIC RADIATION SICKNESS. Sergieva, M. G.; Teterina, V. I. pp 39-43 of Voprosy Radiobiologii i Biologicheskogo Deistviya Tsitostaticheskikh Preparatov. Gol'dberg, E. D. (ed.). Tomsk, USSR; Izdatel'stvo Tomskogo Universiteta (1969). (In Russian).

Guinea pigs were irradiated daily with 6, 12, and 15 R for total doses of 1236 to 2250 R, 1440 to 2122 R, and 735 R, respectively. The animals irradiated with the higher doses succumbed sooner. Histological findings in the eyes are described in detail along with histochemical studies. (TTT)

2924 RADIOPROTECTIVE PROPERTIES OF SELENIUM. Abdullaev, G. B.; Gasanov, G. G.; Mekhtiev, M. A.; Dzhafarov, A. I.; Mazanov, D. M.; Babaev, R. A.; Sadykhov, S. T.; Teplyakova, G. V.; Ragimov, R. N. Dokl. Akad. Nauk Azerb. SSR; 29: No. 3, 12-17(1973). (In Russian).

The radioprotective properties of selenium-containing substances were examined in rats that were x-rayed with different doses. It was found that the selenium-containing substance, used either separately or in the combination with the E and A vitamins, possessed radioprotective properties. The best protective effect was obtained in combined introduction of the selenium-containing substance with the E and A vitamins within half-an-hour before the irradiation. (auth)

2925 COMBINED SURGICAL AND RADIATION INJURY. VI. Evaluation of Wound Contraction and Wound Histology in Whole-Body Irradiated and Bone Marrow Shielded Rodents. Donati, R. M.; Frank, D. F. (St. Louis Univ., MO). J. Nucl. Biol. Med.; 17: No. 1, 30-37(1973).

The healing of a surgically induced non-lethal skin wound was evaluated in normal rats, rats subjected to 800 R whole-body radiation, and rats subjected to 800 R radiation with bone marrow shielding. Irradiation produced a 78% thirty-day mortality that was reduced to 14% by bone marrow shielding. Wound contraction of the whole-body irradiated animals was significantly impaired when compared to the non-radiated animals. Bone marrow shielding produced a reversion of the wound contraction pattern to normal. The wounds of the whole-body irradiated animals demonstrated a less intense cellular infiltrate, increased bacterial invasion, and retarded fibrin formation with delayed healing when compared with non-irradiated wounds. Histologic evaluation revealed only subtle differences between the wounds of the non-radiated and bone marrow shielded irradiated animals. Thus, bone marrow shielding also reversed the histologic sequence of events attendant to radiation toward normal. These results suggest that the bone marrow plays an important role in wound healing in the irradiated animal. The further implications of these findings are discussed. (auth)

2926 HISTOLOGICAL CHANGES IN THE GUINEA PIG LUNG FOLLOWING INHALATION OF FORMALDEHYDE AND ROENTGEN IRRADIATION AND THEIR MODIFICATION THROUGH DEXAMETHASONE-21-ISONICOTINATE. Otte, W.; Kroepelin, K. (Univ., Frieburg i. B.). Arzneim. Forsch.; 23: 420-424(Mar 1973). (In German).

Semiquantitative analysis of histological findings in the bronchopulmonary system of the guinea-pig after inhalation of formaldehyde showed a positive effect of treatment by dexamethasone-21-isonicotinate on the peribronchial cell infiltration in the beginning and in the advanced stage of this pathological reaction. The development of interstitial oedema appeared to be influenced positively. The injuries of rat lungs by 3000 R showed, after prophylactic application of dexamethasone-21-isonicotinate significantly less perivasal enlargement of lymphatic system and less interstitial oedema during the first 24 h after the insult. Later damages caused by reactions to radiation showed no improvement by treatment. (auth)

2927 MORPHOLOGICAL CHANGES IN SMALL INTESTINE EPITHELIUM FOLLOWING SINGLE DOSE IRRADIATION IN THE RAT. Arganini, L.; Castagnoli, P.; De Dominicis, R.; Becciolini, A. (Univ., Florence). Radiol. Med.; 59: No. 8, 739-750(Aug 1973). (In Italian).

Qualitative and quantitative morphological changes associated with variations in enzyme (disaccharase and dipeptidase) activity of the small intestine epithelial cell brush border were studied in 140 female Sprague Dawley rats irradiated with a single 200 to 1200 R ^{60}Co gamma ray dose and sacrificed after periods of 4 hrs to 61 days. (auth)

2928 DIFFERENCES IN THERAPEUTIC RESPONSES TO 2-AMINO-4-HYDROXY-6-(1′, 2′, 3′-TRIHYDROXYBUTYL)-5, 6, 7, 8-TETRAHYDROPTERIDINE IN MIDLETHALLY X- OR ^{60}Co-IRRADIATED MALE AND FEMALE H MICE. Motycka, K.; Slavik, K.; Balcarova, A.; Cihar, R. (Charles Univ., Prague). J. Nucl. Biol. Med.; 17: No. 1, 38-41(1973).

The application of 2-amino-4-hydroxy-6-(1′, 2′, 3′-trihydroxybutyl)-5, 6, 7, 8-tetrahydropteridine in a single dose (0.5 or 2.5 mg/mouse) after x- or ^{60}Co irradiation in midlethal doses was followed by an increase in the number of 30 days survivors. The effect was more pronounced in male mice and after x irradiation than in female mice and after ^{60}Co irradiation. (auth)

2929 SELENIUM AND TUMOR GROWTH IN EXPERIMENTS. Abdullaev, G. V.; Gasanov, G. G.; Pagimov, R. N.; Teplyakova, G. V.; Mekhtiev, M. A.; Dzhafarov, A. I. Dokl. Akad. Nauk Azerb. SSR; 29: No. 3, 18-24(1973). (In Russian).

The effects of selenium-containing substances on the growth of malignant tumors, M-1 sarcoma, Gerene carinoma, and Ehrlich's ascites tumors, were investigated. A delay in the growth of the tumors was observed. The delay in the growth of Ehrlich's ascites tumors was enhanced by a combined treatment of x radiation and selenium-containing substances. Delay was also enhanced by pretreating the tumor cell suspension with heat (40°C) before inoculating into rats. A high degree of immunity was noted in rats treated with selenium. (HLW)

2930 QUANTITATIVE ASPECTS OF DESTRUCTION OF HAEMOPOIETIC TISSUE IN MOUSE RADIATION CHIMAERAS. Boranic, M.; Tonkovic, I.; Blazi, M. (Rudjer Boskovic Inst., Zagreb). Biomedicine; 19: No. 3, 104-107(Mar 1973).

Lethally irradiated mice received cells of syngeneic bone marrow and allogeneic lymph nodes, mixed in ratios ranging from 1 : 1 to 1:90. Marrow cells formed nodules of hemopoietic tissue on the spleens: lymph node cells inhibited the formation of nodules when mixed in a sufficiently high ratio. The ratio required for complete obliteration of the colonies depended on antigenic disparity between the host and the donor, rather than on the size of the host. This technique allows a quantitative estimation to be made of the destructive effect of graft-versus-host reaction on hemopoietic tissue, its primary target. (FR)

2931 REGENERATION OF MOUSE KIDNEY AFTER DAMAGE BY FOLIC ACID, WHOLE-BODY X-RAY IRRADIATION, 2, 4, 6-TRIETHYL-ENIMINO-1, 3, 5,-TRIAZINE, AND POLYANIONS. Tempel, K.; Jaehde, H. (Univ., Munich). Arzneim.-Forsch.; 22: 2126-2128(Dec 1972). (In German).

The increase of protein and DNA content of kidneys of mice damaged by high doses (150 mg/kg body-weight) of folic acid was inhibited by whole-body x irradiation, triethylenemelamine, poly(vinylsulfate), pentosane-polysulfuric acid (Na-salt), high-molecular thymonucleic acid, actinomycin D, puromycin or prednisolone when given 12 h before to 12 h after folic acid in doses of 325 R or 0.125, 25.0, 25.0, 6.25, 0.05, 0.5, and 3.1 mg/kg body-weight resp. (according to the above order). Results suggest that; the measurement of DNA or protein content of the kidneys damaged by high doses of folic acid allows only preliminary conclusions as to the mode of action of the inhibiting agents; polyanions are growth-inhibiting not only in vitro but also in vivo. The mode of action remains to be further investigated. (auth)

2932 ULTRASTRUCTURE OF CHONDROCYTES OF ARTICULAR CARTILAGE SOON AFTER IRRADIATION. Ankina, M. A.; Modyaev, V. P. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 18: No. 11, 45-48(Nov 1973). (In Russian).

The results of electron microscopy about the change of chondrocytes structure of articular cartilage of adult rabbits during the period of 1 to 72 hrs after a single gamma irradiation in a dose of 900 rad are presented. The fate of irradiated cells is different - death under the beam or carbohydrate regeneration, hypertrophy of organelles (compensatory reaction), and dedifferentiation of some chondrocytes (reserve of regeneration). The effect of radiation during the studied terms manifested itself mainly in the upper part of the tissue (up to the columns). The cells of the isogenic group suffer the greatest damage. The authors' opinion is that not all the ultrastructure changes of irradiated chondrocytes of articular cartilage should be considered as damage. (auth)

2933 SPLIT-BRAIN CATS PREPARED BY RADIOSURGERY. Gaffey, C. T.; Montoya, V. J. (Univ. of California, Berkeley). Int. J. Radiat. Biol.; 24: No. 3, 229-242(Sep 1973).

Cats with their optic chiasma and commissural system disconnected along the mid-sagittal plane are of special value in central nervous system research. The feasibility of producing such split-brain cats with heavy-particle radiation was attempted. Focused, 910-MeV helium ion particles from the Berkeley cyclotron were restricted to a blade-like beam that was oriented to pass between the cerebral hemispheres. Because of their superior non-scattering property, helium particles retained their sharply defined beam even after passage through brain tissue along the cat's longitudinal fissure. The efficiency of helium ions in blocking interhemispheric transfer was tested using electrophysiologic techniques. The corpus callosum was permanently implanted with pairs of wire electrodes in the genu and splenium on either side of the interhemispheric fissure. The time-dose relationship to abolish electrically initiated transcallosal action potentials (TCAP) was investigated. The post-irradiation interval to inhibit TCAP was an inverse function of the logarithm of the absorbed dose over 10 krads of helium ion radiation. TCAP could be selectively inhibited either in the region of the genu, or the splenium. Transmission of the entire corpus callosum could be blocked by a 2 × 25.4 mm helium ion beam. When the corpus callosum absorbed less than 10 krads of helium ions TCAP were not abolished. A very fine helium ion beam, 0.5 × 25.4 mm, was not successful in halting TCAP, even though the corpus callosum absorbed 50 krads of radiation. The radiovulnerability of the small-calibre nerve fibres (1 μ and less) that constitute the corpus callosum is discussed. (auth)

2934 ACUTE MORTALITY AND CHANGES IN BODY-WEIGHT OF MICE AFTER PARTIAL-BODY IRRADIATION WITH X RAYS AND FAST NEUTRONS. Matsuzawa, H.; Kawashima, K.; Inada, T.; Hiraoka, T.; Shiragai, A.; Sato, F.; Tsuchihashi, S. (National Inst. of Radiological Sciences, Chiba, Japan). Int. J. Radiat. Biol.; 24: No. 3, 275-283(Sep 1973).

Acute mortality and changes in body-weight were studied in CRF_1 female mice after trunk irradiation with 200-kV x rays and fast neutrons produced by the Be(d,n) reaction with 2.8-MeV deuterons. For the neutron beam, including its inherent gamma contamination, LD_{50} values of 412 rads and 527 rads and RBE values of 3.1 and 2.7 were obtained for 30-day mortality and 5 day mortality, respectively. For changes in body-weight of surviving mice, a single minimum was found after trunk irradiation with x rays as well as neutrons. The minimum weight, the time at which this occurred, and the time of recovery to the initial weight level were correlated with dosage. (auth)

2935 RELATIVE BIOLOGICAL EFFECTIVENESS OF X-RAYS AND FAST NEUTRONS IN INDUCING TRANSLOCATIONS IN MOUSE SPERMATOGONIA. Muramatsu, S.; Nakamura, W.; Eto, H. (National Inst. of Radiological Sciences, Chiba, Japan). Mutat. Res.; 19: No. 3, 343-347(Sep 1973).

The dose-response relationships for inducing translocations in the spermatogonia of mice were studied, and they were compared for 200 kVp x-rays and 2-MeV fast neutrons. The dose response for fast neutrons was markedly convex; more precisely, the response obtained was linear in the dose range from 24 to 94 rad with a regression coefficient of $11.36 \cdot 10^{-4}$, but decreased for a further increase in dose up to 267 rad. On the other hand, that for x-rays showed a linear dose-response relationship from 48 to 672 rad with a regression coefficient of $2.69 \cdot 10^{-4}$. The relative biological effectiveness for inducing translocations in the spermatogonia of mice was compared for the linear parts of the dose response in both types of radiation, and the relative biological effectiveness (RBE) value was 4.22. (auth)

2936 BIOCHEMICAL ASPECT OF THE BIOLOGICAL ACTION OF A LOW-FREQUENCY PULSED ELECTROMAGNETIC FIELD. Kolodub, F. A.; Evtusenko, G. I. Gig. Tr. Prof. Zabol.; 16: No. 6, 13-17(Jun 1972). (In Russian).

The effect of a pulsed electromagnetic field at various voltages on the carbohydrate and nitrogen metabolism in the rat was studied. It was found that exposure to a pulsed electromagnetic field produced pronounced metabolic disorders in the brain, liver, heart and lung muscles. Carbohydrate metabolism disorders are characterised by an adenosine triphosphate and creatinine phosphate deficit due to the inhibition of oxidative phosphorylation inadequately compensated by excessive glycolysis, which results in a reduction in glycogen and an accumulation of lactic acid. In view of these results, the biochemical mechanisms of the action of a pulsed electromagnetic field on the living body were studied. (Occup. Saf. Health Abstr.)

2937 DEFECTIVE CAPACITY OF BONE MARROW FROM NUDE MICE TO RESTORE LETHALLY IRRADIATED RECIPIENTS. Zipori, D.; Trainin, N. (Weizmann Inst. of Science, Rehovot, Israel). Blood; 42: No. 5, 671-678(Nov 1973).

The proliferative capacity of bone marrow cells from thymus-deprived nude mice was investigated in lethally irradiated recipients. Although the colony-forming capacity of these cells was found to be similar to that of normal littermates, a reduction in the number of nucleated cells was observed in the bone marrow of nude mice. Moreover when the radioprotective effect of such cells was studied, 5×10^5 or 2×10^6 bone marrow cells from nude mice were less effective in restoring hemopoiesis and establishing permanent chimerism than similar amounts of bone marrow cells of normal controls. In addition, irradiated animals surviving after injection of bone marrow cells from nude mice were found to have lower immune responses to SRBC than normal chimeras. The possibility that mortality of irradiated recipients injected with bone marrow of nude mice is due to the presence of a latent infective agent or of some inhibitory factor of hematopoiesis in the bone marrow of such nude mice is shown to be improbable. Alternatively it is suggested that nude mice suffer from an intrinsic defect in the proliferative capacity of their bone marrow colony-forming cells (CFUs). (auth)

Invertebrates

2938 RADIORESISTANCE OF A NATURAL POPULATION OF DROSOPHILA WILLISTONI LIVING IN A RADIOACTIVE ENVIRONMENT. Cordeiro, A. R. (Univ. Federal do Rio Grande do Sul, Porto Alegre, Brazil); Marques, E. K.; Veiga-Neto, A. J. Mutat. Res.; 19: No. 3, 325-329(Sep 1973).

Two experiments were performed on egg eclosion and on reproductive performance, each with two sets of paired random crosses of F_1 from D. willistoni females, collected in a radioactive wood (RW) and submitted to a radiation test of 1000 R. There was significantly less decrease in egg eclosion and reproductive performance than in the parallel crosses with strains coming from a control forest (CW). The relatively low level of natural environment radiation, 0.05 mR/h to 3.5 mR/h, is surprisingly effective in the development of radioresistance. (auth)

2939 EFFECT OF HYPOXIA ON RADIATION LIFE-SHORTENING IN DROSOPHILA MELANOGASTER. Mill, A. J.; Davies, R. W.; Thompson, S. C.; Atherton, H. A.; Lindop, P. J.; Hollingsworth, M. J. (St. Bartholomew's Hospital, London). Int. J. Radiat. Biol.; 24: No. 3, 297-305(Sep 1973).

Radiation-induced life-shortening in Drosophila melanogaster was measured. Flies were irradiated with 14-MeV electrons at a dose-rate of 1430 rads/sec while breathing various mixtures of oxygen and nitrogen. Neither a detectable age dependence nor a sex difference was noted. There was no difference in sensitivity with oxygen contents of 6 to 21%; under 100% nitrogen, life-shortening was reduced. This difference in sensitivity was due to an increase in the plateau region at low doses for nitrogen. For higher doses inactivation constants for both sets of curves were similar. Thus the o.e.r. was dependent on the level of damage. For the acute effects of radiation there was no protection under nitrogen. It is pointed out that this study is relevant to the effects of radiation on post-mitotic normal tissue. (UK)

2940 INCREASE IN FERTILITY, WITH REPEATED MATING, OF GAMMA IRRADIATED MALE CODLING MOTHS, LASPEYRESIA POMONELLA (L.) (LEPIDOPTERA: OLETHREUTIDAE). Robinson, A. S. (Dept. of Agriculture, Summerland, B. C.). Can. J. Zool.; 51: No. 4, 427-430(Apr 1973).

Male codling moths, Laspeyresia pomonella (L.) irradiated with 30 krad of gamma radiation mated fewer times and induced a poorer ovi-positional response in mated females than did nonirradiated males. The fertility of the nonirradiated males was not affected by repeated mating but there was a significant increase in the fertility of consecutive matings of the irradiated males with nonirradiated females, as measured by mean percentage egg hatch. This is thought to be due to recovery from specific somatic damage. The transfer of a spermatophore by either type of male did not always result in oviposition, but this malfunction of the male occurred significantly more times in the irradiated series. (CA)

2941 EFFECT OF X RADIATION ON SPERMATOGENESIS AND THE FERTILITY OF SCHISTOCERCA GREGARIA (FORSK.). Coggins, P. B. (Chelsea Coll. of Science and Tech., London). J. Embryol. Exp. Morphol.; 30: No. 1, 163-177(Aug 1973).

Normal spermatogenesis and the effects of x radiation on the male locust germ cells were studied with the aid of light and electron microscopy. Adult insects were irradiated with doses of 100 to 500 rad (i.e., 1 to 5 J kg^{-1}) and subsequently examined, at intervals, up to 55 days later. In secondary spermatogonia, all doses caused nuclear fragmentation and necrosis, and in primary spermatogonia and a few spermatocytes caused a delay in division. Spermatids and the majority of spermatocytes developed into spermatozoa that were passed from the follicles to the seminal vesicles. The supply of sperm was, subsequently, temporarily stopped. The follicles were eventually repopulated by the division of the primary spermatogonia. Radiation-induced abnormalities, e.g. the formation of supernumerary centrioles, flagella, and definitive mitochondria, were most common in the cytoplasm. The Golgi bodies and acrosome seemed to be unaffected. Abnormal outgrowths of the late spermatid and sperm nuclei appeared to be caused by the presence of the numerous centrioles and flagella. The bright yellow coloration of the cuticle, which is characteristic of sexually mature males, was not fully developed in irradiated males. Breeding experiments showed a significant reduction, when compared to the controls, in the number and percentage hatchability of eggs obtained from females mated to irradiated males. The doses of radiation employed did not appear to affect the longevity of the adults. (auth)

2942 RADIATION-INDUCED PARTIAL STERILITY RELATED TO STRUCTURALLY ABNORMAL SPERMS OF PLODIA INTERPUNCTELLA (LEPIDOPTERA: PHYCITIDAE). Ashrafi, S. H.; Roppel, R. M. (Stored-Product Insects Research and Development Lab., Savannah, GA). Ann. Entomol. Soc. Amer.; 66: No. 6, 1309-1314(Nov 1973).

Sperms in the testes of adult Indian meal moths, Plodia interpunctella (Hübner), were studied by electron-microscopy after irradiation of the insects in either the last instar or in the early adult stage. Irradiation of newly eclosed adults resulted in rupture and dispersal of sperm bundles and a few flagellar abnormalities in eupyrene sperms. Irradiation of the larvae resulted in high frequencies of flagellar and apical abnormalities of eupyrene sperms of P_1 adults. These genetic abnormalities in the ultrastructure of the sperms were inherited more intensely in F_1 progeny, produced from the cross of P_1 male adults with the unirradiated females. (auth)

2943 OVIPOSITIONAL RESPONSE ELICITED BY NORMAL, IRRADIATED, F_1 MALE PROGENY, OR CASTRATED MALE TRICHOPLUSIA NI (LEPIDOPTERA: NOCTUIDAE). Karpenko, C. P.; North, D. T. (Metabolism and Radiation Research Lab., Fargo, ND). Contract AT(47-7)-3028. Ann. Entomol. Soc. Amer.; 66: No. 6, 1278-1280(Nov 1973).

The ovipositional response of untreated Trichoplusia ni (Hübner) females that had mated to unirradiated, irradiated, F_1 male progeny from irradiated males, or castrated males was studied. Females that mated with irradiated males or F_1 sons of irradiated males oviposited fewer eggs than females that mated with control males, when all females had received a normal quantity of eupyrene and apyrene sperm. Irradiated males and F_1 sons of irradiated males that transferred an apparently normal sperm complement elicited significantly better oviposition from untreated females than did treated males that transferred mostly apyrene sperm, apyrene sperm only, or no sperm. Males in the latter categories elicited a better ovipositional response from the untreated females than was observed in virgin females. Normal eupyrene sperm and possibly at least 1 accessory fluid are required to initiate a completely normal ovipositional response in cabbage looper females. The accessory secretion triggers a significant increase in oviposition, but the greatest increase occurs when males contribute normal amounts of eupyrene sperm. The initiation of oviposition and female receptivity may be closely related in this species. (auth)

2944 RADIATION-INDUCED ALTERATION OF TESTES OF LARVAE OF THE INDIAN MEAL MOTH, PLODIA INTERPUNCTELLA (HUBNER) (LEPIDOPTERA: PHYCITIDAE). Ashrafi, S. H.; Roppel, R. M. (Stored-Product Insects Research Development Lab., Savannah, GA). Ann. Entomol. Soc. Amer.; 66: No. 6, 1324-1328(Nov 1973).

Ultrastructural analysis of testes of 13-day-old control larvae of Plodia interpunctella (Hübner) revealed fine structural characteristics of spermatogonia and spermatocytes similar to those reported by earlier workers. Spermatids possessed dual mitochondrial derivatives in various stages of elongation arranged parallel to the probable axoneme complex. Larvae irradiated at 3.5 krad on the 12th day and examined 24 h later exhibited early-stage spermatogonia in the process of necrosis and cytolysis. Spermatocytes showed evidence of nuclear damage but divisional processes appeared normal. In larvae irradiated at 12.5 krad on the 12th day and dissected 24 h later, obvious cell damage and depletion were observed in both spermatogonia and spermatocyte cysts. Elongating spermatids exhibited mitochondrial derivatives with disordered cristae patterns, but the possible axoneme structure maintained normal morphology. Maturation divisions appeared to have been arrested. (auth)

Radionuclide Effects (Internal Source)

Man

2945 MORPHOLOGICAL CHANGES IN THE LUNGS WITH CHRONIC INHALATION OF THORIUM DIOXIDE. Likhachev, Yu. P.; Lyarskii, P. P.; Elovskaya, L. T. Med. Radiol.; 18: No. 11, 35-41(Nov 1973). (In Russian).

Pathological changes of critical organs with long-term chronic inhalation of thorium dioxide found in micropathogenic dust of laporite concentrate in different percentages are described. The relation between the specific activity of dust in the air, the doses absorbed by the lungs, and the development of pneumoconiosis was established. Dust of thorium dioxide with chronic inhalation in the course of 9 months caused the development of vigorously progressing diffuse-focal pneumosclerosis in an absorbed dose of more than 1000 rad. In the lympth nodes progressing atrophy of lymphoid cells is developing. (auth)

2946 TREATMENT OF HYPERTHYROIDISM WITH SODIUM IODIDE ^{131}I. Kreps, E. M.; Kreps, S. M.; Kreps, S. I. (Lenox Hill Hospital, NY). J. Amer. Med. Ass.; 226: No. 7, 774-775 (12 Nov 1973).

A 38-year-old woman had papillary carcinoma of the thyroid when surgery for adenomatous goiter was performed 20 years after treatment of hyperthyroidism with sodium iodide I-131. To our knowledge, this is the ninth reported case of microscopically proved cancer following such therapy, and it is the one with the longest interval since treatment. (auth)

Animals

2947 APPROXIMATION OF RADIATION EXPOSURE BY ^{125}I-LABELLED FIBRINOGEN. Farkas, G.; Kutas, V.; Predmerszky, T. (Orszagos Frderic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest). Izotoptechnika; 16: No. 7-8, 357-363(1973). (In Hungarian).

Iodine-125-labeled fibrinogen was injected into rats. The animals were billed after 10 min, 3, 6, 24, 72, and 144 hrs, respectively, and the weight and activity of the lungs, liver, spleen, kidneys, stomach, gonads, thyroid, and intestines were determined. (auth)

2948 EFFECT OF TRITIATED THYMIDINE ON THE DEVELOPING OOCYTES OF MICE. Baker, T. G.; McLaren, A. (Univ. of Edinburgh). J. Reprod. Fert.; 34: No. 1, 121-130 (Jul 1973).

Pregnant Q strain mice received seven injections of tritiated thymidine (4, 40, or 400 μCi/dose) between the 13th and 16th days of pregnancy, and the ovaries of their female progeny were studied. Radioactive label was detected by autoradiography in a high proportion of the oocyte nuclei on the 17th day of gestation, and up to 1 month after birth. The total number of oocytes in the ovaries was reduced. The reduction was proportional to the dose of isotope used, and affected primordial follicles more than multilayered follicles. By 5 months of age, the numbers of oocytes in the 40-μCi and 4-μCi groups were reduced to about 1 and 50% of the control values, respectively. Body weight, fertility, ovarian weight, and the capacity of the ovary to undergo compensatory hypertrophy after unilateral ovariectomy were all affected in the 400-μCi group. It is concluded that mouse oocytes are highly sensitive to internal β-radiation from [^{3}H] thymidine incorporated during embryonic life. (auth)

2949 BLASTOMOGENIC EFFECT IN CONTINUOUS UPTAKE OF SOME RADIONUCLIDES AND PERSISTANT EXTERNAL IRRADIATION. Zapol'skaya, N. A.; Lavrent'ev, L. P.; Zhorno, L. Ya. (Research Inst. of Radiation Hygiene, Leningrad). Vop. Onkol.; 19: No. 9, 80-85(1973). (In Russian).

The reported experimental data are concerned with the frequency of tumor incidence, peculiarities of their localization and morphological structure in rats in per oral administration of Sr-90, Cs-137, I-131 and external irradiation under conditions of a continuous experiment. There was shown a definite correlation between the type of the radiation effect and total absorbed dose and tumor development. Tumor localization was mainly conditioned by the character of radionuclide distribution in the organism. The frequency of tumor incidence was dependent on the radiation dose. However, in proportional doses the blastomogenic efficacy of Sr-90 was found to be higher than that of Cs-137, I-131 and external irradiation. A minimum osteosarcomogenic dose in Sr-90 injection was approximately 1000 rad. (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 2632 and 2986.

2950 MODE OF EXCRETION AND THE METABOLIC BEHAVIOR OF ^{99m}Tc-PERTECHNETATE IN THE HUMAN BODY. Herzfeld, U. (Univ., Heidelberg). Therapiewoche; 23: No. 18, 1568-1572(1973). (In German).

As the directed investigations have shown, ^{99m}Tc-pertechnetate is individually differently excreted via the kidneys as well as via stomach-intestines. The mode of excretion of pertechnetate according to the method of administration (intravenous or oral) has been examined comparing a "normal collective" to renal insufficiencies as well as a collective "blocked renal tubule". The measurements of the activity concentrations were carried out in the Heidelberg Whole-Body Counter. Independent of the method of administration, a higher concentration of the substance was found in the feces of limited renal functioning as compared with healthy kidneys. Thus a processing of pertechnetate by the renal tubule system is concluded. The calculated clearance value of this substance, however, suggests a high tubular re-absorption rate. From the concentration rate of pertechnetate in serum and in whole blood as well as the increased value with time of the volume of distribution within the body, one can conclude that there is an intra-cellular deposit of the substance. (GE)

2951 LOWERING OF THE RADIOACTIVE BURDEN OF RADIOMERCURY COMPOUNDS BY CHELATE FORMATION. Szabo, I. (Fovarosi Onkoradiologiai Intezet, Weil Emil Terueleti Vezeto Korhaz, Budapest). Izotoptechnika; 16: No. 7-8, 473-475(1973). (In Hungarian).

Mercury-203-labeled EDTA is more reliable in scintigraphy of tumors than ^{203}Hg-Neohydrin. The higher burden to kidneys is lowered to the value of the burden from ^{203}Hg-Neohydrin by excess introduction of EDTACAL. (auth)

2952 SIMPLE METHOD OF ESTIMATING RENAL CLEARANCE BY RENOGRAPHY. Meldolesi, U.; Mombelli, L.; Roncari, G.; Conte, L. (Univ., Milan). J. Nucl. Biol. Med.; 17: No. 2, 79-83(1973).

A method of estimating from renography the fractional clearance of the radio-compound during the course of the first minute after the injection was described. The results obtained were found to be proportional to the clearance rate corrected to the body surface area. On the basis of this proportionality, the clearance of the radio-compound used in renography can be estimated with a relative error of about 10%, which can be considered as acceptable in a method put forward essentially for clinical use. (auth)

2953 FLUORINE-18 BONE SCINTIGRAPHY IN CHILDREN WITH OSTEOSARCOMA OR EWING'S SARCOMA. McNeil, B. J.; Cassady, J. R.; Geiser, C. F.; Jaffe, N.; Traggis, D.; Treves, S. (Harvard Medical School, Boston). Radiology; 109: No. 3, 627-632(Dec 1973).

Serial fluorine-18 bone scans and skeletal surveys were evaluated for usefulness in the staging of initial disease and for detection of metastases in children with osteosarcoma or Ewing's sarcoma. Scintigraphy was more sensitive than skeletal surveys in the detection of bony metastases in both tumors, but was less sensitive than radiographs for the detection of pulmonary lesions. Bone metastases did not occur before pulmonary metastases in patients with osteosarcoma but did in patients with Ewing's sarcoma. The effect of radiation therapy on the distribution of fluorine 18 throughout the bony skeleton is discussed. (auth)

Animals

Refer also to abstracts 2947, 2965, and 2966.

2954 METABOLISM OF MERCURASCAN-^{203}Hg BY RATS AND DOGS. Dreyfuss, J.; Ross, J. J. Jr.; Shaw, J. M. (Squibb Inst. for Medical Research, New Brunswick, NJ). J. Nucl. Biol. Med.; 17: No. 2, 43-50(1973).

Mercurascan-^{203}Hg (0.1 mg/kg) was administered i.v. to rats and dogs. Blood levels of total radioactivity were similar in both species, and no significant differences were found in the kinetics of elimination. Radioactivity was 97% bound to plasma proteins of a dog. Tissues of rats or dogs did not appear to concentrate radioactivity, with the exception of the kidneys and liver. Radioactivity in the kidneys of rats or dogs was excreted very slowly, but most of the radioactivity in the livers of rats was eliminated in 4 days. The excretion of Mercurascan-^{203}Hg by both species was predominantly in the feces; the bile is the source of the radioactivity excreted in the feces. Most of the radioactivity found in the feces of rats and dogs was excreted during the first 24 hrs after animals had been dosed, but radioactivity continued to be excreted by dogs in the urine and feces in small amounts for at least 3 weeks. Dog bile contains a glucuronide conjugate of one or more of the mercurial derivatives of fluorescein. Two metabolites were excreted in rat urine and at least one in rat feces that are chromatographically different from any of the principal components of mercurascan-^{203}Hg. These results indicate that Mercurascan-^{203}Hg is extensively biotransformed by rats and dogs. (auth)

2955 RETENTION OF RADIOACTIVE METAL COMPLEXES IN RATS. Mate, L. (Orszagos Frederic Joliot-Curie Sugarbiological es Sugaregeszseguegyi Kutato Intezet, Budapest); Varga, L.; Farkas, G.; Pal, I.; Feher, I. Izotoptechnika; 16: No. 7-8, 465-472(1973). (In Hungarian).

Distribution and retention of ^{58}Co-DTPA and ^{51}Co-EDTA in organs was studied. Cobalt complex is metabolized in cells, the metal ions are deposited in the organs. With the chromate complex only a small proportion of metal ion leaves the compound. Radiation dose from 30 μCi ^{58}Co-DTPA amounts to 7.2 mrad, that from ^{51}Cr-DTPA, 300 μCi to 0.21 mrad. (auth)

2956 COMPARISON BETWEEN THE RATE OF TRANSFER OF ^{226}Ra FROM POTABLE WATER OR HAY TO COW MILK. Kirchmann, R.; Lafontaine, A.; Van den Hoek, J.; Koch, G. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). Compt. Rend. Soc. Biol.; 166: No. 11, 1557-1562(1972). (In French).

Radium-226 contained in feeding water is eliminated in milk in proportions of considerably less than 1%; individual variations can, however, exceed this value by a factor of two. The radium transfer rate from hay harvested in meadows contaminated by radioactive wastes is between three and six times higher: a possible explanation is the conformation of stomachs of ruminants that rapidly deal with water but subject grass foods to an extensive predigestion. Nevertheless the amount of radium-226 eliminated into the milk of cows fed with hay contaminated at levels of between 420 and 509 picocuries per kilogram remains within the limits set by the International Radiobiological Protection Committee. (FR)

2957 ENTEROHEPATIC CIRCULATION OF ^{64}Cu, ^{52}Mn, AND ^{203}Hg IN RATS. Cikrt, M. (Institut Hygieny a Epidemiologie, Prague). Arch. Toxikol.; 31: No. 1, 51-59(1973).

The intestinal absorption of $^{64}CuCl_2$, $^{52}MnCl_2$, and $^{203}HgCl_2$ was compared with those of biliary excreted radiometals in rats during 24 h after intraduodenal administration. Biliary excreted metals were obtained from rats (donors) given previously intravenously $^{64}CuCl_2$, $^{52}MnCl_2$, and $^{203}HgCl_2$. The metals in the form of chloride salts as well as the metals, excreted via bile, were given to control groups or acceptor rats in the same dose intraduodenally. For manganese, given as $^{52}MnCl_2$, 15.04 ± 8.48% was absorbed, whereas for biliary excreted ^{52}Mn 35.45 ± 5.72% was absorbed. Biliary excreted manganese is probably in the bile in form suitable for intestinal absorption. In both other metals the intestinal absorption was higher when metal in form of chloride salt was administered (in ^{64}Cu 46.45 ± 11.46% respectively 16.74 ± 8.53%; in ^{203}Hg 40.9 ± 8.52% respectively 21.08 ± 10.7%). A possibility of treatment of metal intoxication by influencing of enterohepatic circulation of metals is discussed. (auth)

2958 EFFECTS OF GALLIUM (Ga^{3+}) ON RADIOCALCIUM METABOLISM IN TUMORS. Anghileri, L. J. (Ruhr Univ., Ger.). J. Nucl. Biol. Med.; 17: No. 1, 1-4(1973).

The effects of gallium ion (Ga^{3+}) on the uptake of $^{45}CaCl_2$ by ascitic and by solid tumors were studied. Gallium behaves modifying the tumor cell calcium metabolism in a way that corroborates its characteristics of calcergen. In addition, it seems that its biological reactivity depends upon its metabolic transformation into a soluble form. (auth)

Microorganisms

2959 FATE OF LABELED HYDROXAMATES DURING IRON TRANSPORT FROM HYDROXAMATE-IRON CHELATES. Arceneaux, J. E. L.; Davis, W. B.; Downer, D. N.; Hayden, A. H.; Byers, B. R. (Univ. of Mississippi, Jackson). J. Bacteriol.; 115: No. 3, 919-927(Sep 1973).

The fate of the hydroxamic acid-iron transport cofactors during iron uptake from the $^{59}Fe^{3+}$ chelates of the ^{3}H-labeled hydroxamates schizokinen and aerobactin was studied by assay of simultaneous incorporation of both $^{59}Fe^{3+}$ and ^{3}H. In the schizokinen-producing organism Bacillus megaterium ATCC 19213 transport of $^{59}Fe^{3+}$ from the ^{3}H-schizokinen-$^{59}Fe^{3+}$ chelate at 37 C was accompanied by rapid uptake and release (within 2 min) of ^{3}H-schizokinen, although ^{3}H-schizokinen discharge was temperature-dependent and did not occur at 0 C. In the schizokinen-requiring strain B. megaterium SK 11 similar release of ^{3}H-schizokinen occurred only at elevated concentrations of the double-labeled chelate; at lower chelate concentrations, ^{3}H-schizokinen remained cell-associated. Temperature-dependent uptake of deferri (iron-free) ^{3}H-schizokinen to levels equivalent to those incorporated from the chelate form was noted in strain SK 11, but strain ATCC 19213 showed only temperature-independent binding of low concentrations of deferri ^{3}H-schizokinen. These results indicate an initial temperature-independent binding of the ferric hydroxamate which is followed rapidly by temperature-dependent transport of the chelate into the cell and an enzyme catalyzed separation of iron from the chelate. The resulting deferri hydroxamate is discharged from the cell only when a characteristic intracellular concentration of the hydroxamate is exceeded, which happens in the schizokinen-requiring strain only at elevated concentrations of the chelate. This strain also appears to draw the deferri hydroxamate into the cell by a temperature-dependent mechanism. The aerobactin-producing organism Aerobacter aerogenes 62-1 also demonstrated rapid initial uptake and temperature-dependent discharge of ^{3}H-aerobactin during iron transport from ^{3}H-aerobactin-^{59}Fe^{3+}, suggesting a similar ferric hydroxamate transport system in this organism. (auth)

2960 HYDROXAMATE RECOGNITION DURING IRON TRANSPORT FROM HYDROXAMATE-IRON CHELATES. Haydon, A. H.; Davis, W. B.; Arceneaux, E. L.; Byers, B. R. (Univ. of Mississippi, Jackson). J. Bacteriol.; 115: No. 3, 912-918(Sep 1973).

Kinetics of radioactive iron transport from three structurally different secondary hydroxamate-iron chelates (schizokinen-iron, produced by Bacillus megaterium ATCC 19213; Desferal-iron, produced by an actinomycete; and aerobactin-iron, produced by Aerobacter aerogenes 62-1) revealed that B. megaterium SK 11 (a mutant that cannot synthesize schizokinen) has a specific transport system for utilization of ferric hydroxamates with a recognition capacity based on the chemical structure of the hydroxamate. Both Desferal and schizokinen enhanced iron uptake in this organism; however, Desferal-iron delivered only one-sixth the level of iron incorporated from the schizokinen-iron chelate. Desferal-iron did not generate the rapid rates of iron transport noted with schizokinen-iron at elevated iron concentrations. Assays containing large excesses of either iron-free Desferal or iron-free schizokinen suggested that the iron-free hydroxamate may compete with the ferric hydroxamate for acceptance by the transport system although the system has greater affinity for the iron chelate. Aerobactin-iron did not stimulate iron uptake in B. megaterium SK 11 and aerobactin inhibited growth of this organism, indicating that B. megaterium SK 11 cannot efficiently process the aerobactin-iron chelate. (auth)

New Tracer Techniques

Refer also to abstracts 2951–2953.

2961 (BNL-18258) RECENT ADVANCES IN TECHNETIUM-99m RADIOPHARMACEUTICALS. Richards, P.; Smith, T. D. Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 7p. (CONF-730944-1). Dep. NTIS $3.00.

From 11th international annual meeting of the German Society of Nuclear Medicine; Athens, Greece (24 Sep 1973).

The development of a number of new technetium-99m-labeled radiopharmaceuticals for use in scintiscanning is described. The effectiveness of colloids, chelates, and complexes that localize in a variety of body organs is discussed. The use of ^{99m}Tc-labeled red blood cells for cardiovascular diagnostics is discussed. (CH)

2962 (CNEA-346) PREPARATION OF THYROID STIMULATING HORMONE OF HIGH SPECIFIC ACTIVITY. Barmasch, M.; Nieto de Nunez, G.; Altschuler, N.; Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 14p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

Preparation of thyroid stimulating hormone labeled with ^{131}I of specific activity 150-250 mCi/mg, utilizing the technique of Hunter and Greenwood, is described. Assays were performed in order to demonstrate preservation of the structure of the protein molecule, as well as for the development of different radioimmunologic techniques: chromatoelectrophoresis, alcohol-saline precipitation, charcoal–dextran and double antibody. This last proved to be more efficient. (auth)

2963 (IRE-4/1973) RADIOIMMUNOASSAY: PRINCIPLES AND TECHNIQUES. Reuter, A. M.; Hendrickx, J. C.; Franchimont, P. (Institut National des Radioelements, Brussels (Belgium)). Apr 1973. 12p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The general principles of the radioimmunological method have been defined, as well as the necessary condition for the sensitive and precise radioimmunological determination of hormones. Different separation methods have been compared. The different criteria determining the choice of an adequate method for the preparation of kits for radioimmunological determinations are discussed. (auth)

2964 DETERMINATION OF THE CONTENT OF FOLLICLE-STIMULATING HORMONE IN THE BLOOD PLASMA OF CHILDREN, HEALTHY MEN, AND WOMEN DURING MENOPAUSE WITH THE AID OF A RADIOIMMUNOLOGICAL TECHNIQUE. Chemodanov, V. I.; Sel'verova, N. B. Probl. Endokrinol.; 19: No. 4, 13-17(1973). (In Russian).

A method of radioimmunological determination of FSH in the blood plasma with the use of ^{131}I and the technique of double antibodies is described. Forty eight children under puberty, 36 men, and 34 women during the menopause were examined. Biological and the described methods were applied to the study of various gonadotropin preparations. A conclusion was drawn that this method was sufficiently sensitive and specific and gave reproducible results, although they depended on the FSH/LH ratio. An attempt was made to use kaolin-acetone precipitates of the urine for determination of FSH in them with the aid of the system described. A low yield of the hormone that was explained by inadequate specificity and poor purification of the extracts was obtained. The role of urinary and hypophyseal standards is discussed. (auth)

2965 NUCLEOMEDICAL STUDIES ON THE RETICULO-ENDOTHELIAL SYSTEM IN BONE MARROW. 5. Reticuloendothelial Uptake of Intravenous Hemolysates: A Simulation of the Intravascular Hemolytic Sequelae. Okuyama, S.; Ito, Y.; Sato, T. (Tohoku Univ., Sendai). Sci. Rep. Res. Inst., Tohoku Univ., Ser. C; 19: No. 3, 106-111(Nov 1972).

In exploration of prospects and possible limitations of ^{113m}In-chondroitin sulfate colloid (^{113m}In-ChS) as an improved bone marrow seeker developed in our laboratory, saponin was observed to induce extreme reticuloendothelial (RE) hypofunction. Possible RE blockade from saponin-induced hemolysis was suspected beside its toxic and suppressive effects on marrow RE activity. RE function was assessed with ^{113m}In-ChS at various intervals after intravenous hemolysates in the rabbit by organ radioassay technic. The hemolysate resulted in immediate RE hypofunction, especially in the spleen and liver. Marrow RE suppression was visualized by marrow scanning. The hypofunction may result from phagocytosis of the ghost cells and hemoglobin by cells of the RE organs; the saponin-induced marrow RE hypofunction, however, is much severer than this. The studies indicate that ^{113m}In-ChS is especially suitable for assessment of the marrow RE activity and its imaging. (auth)

2966 TRANSPORT OF RADIOACTIVELY LABELED PROTEINS IN THE VISUAL SYSTEM OF THE CHICK. Crossland, W. J.; Cowan, W. M.; Kelly, J. B. (Washington Univ., St. Louis). Brain Res.; 56: 77-105(29 Jun 1973).

The transport of proteins synthesized in the somata of retinal ganglion cells of 3 to 5 week-old chicks was studied autoradiographically and by liquid scintillation counting following the intravitreal injection of ^{3}H-leucine or ^{3}H-proline. Most of the transported proteins move with a velocity of 1.5 to 2 mm/day and are distributed throughout the extent of the optic nerve and to the various diencephalic and mesencephalic structures to which it sends fibers. A relatively small proportion of the transported material has a rate of approximately 200 mm/day and is preferentially (but not exclusively) distributed to the region of the axon terminals. The differential distribution of the two components is readily demonstrated by grain counts in autoradiographs of the optic tectum: the rapid phase clearly labels the outer laminae of the stratum griseum et fibrosum superficiale in which the retinal fibers terminate very heavily, whereas the arrival of the slow phase results in an increasing grain density over the optic nerve fibers in the stratum opticum. (INIS)

2967 HGH RADIOIMMUNOASSAY. Glucagon and L-Dopa Stimulation Tests. Troncone, L.; Martino, F.; Barbarino, A.; Velardo, A. (Univ. Cattolica del Sacro Coure, Rome). J. Nucl. Biol. Med.; 17: No. 2, 84-91(1973).

A double antibody HGH radioimmunoassay procedure is reported. Results in basal conditions and following Glucagon and L-Dopa provocative tests in normal subjects and in some pathological conditions are reported and discussed. The method described proved to be a fast procedure, practical, and suitable for routine work. Values obtained are accurate and well reproducible. The provocative tests used are innocuous and seem to be a fine means of investigation on HGH release and its dynamics. (auth)

2968 RADIOCARDIOGRAPHY WITH SCINTILLATION CHAMBER. Taehti, E.; Riihimaeki, E. Magy. Radiol.; 25: No. 4, 232-235(Aug 1973). (In Hungarian).

Indium-113m isotope is introduced as tracer element into the cubital vein. The activity of the isotope is 10 mCi. The gamma-chamber is placed over the heart in such manner that the circulation of the right and left heart can be separated in the radiocardiogram. Two radiograms are made per sec., and the information obtained is put on a magnetic ribbon. The activity curves are designed by an analyser, and their evaluation is made by a computer. Using analogous computer, the volumes of each cardiac cavity may be determined. The method is suitable for the selection of the patients for angiocardiographic examination. (auth)

2969 DETERMINATION OF LEFT VENTRICULAR END-DIASTOLIC VOLUME (EDV) BY MEANS OF ^{133}Xe WASH-OUT. Kasalicky, J.; Jebavy, P.; Ressl, J.; Stanek, V. (Research Center of Cardiovascular Diseases, Prague). J. Nucl. Biol. Med.; 17: No. 2, 51-57(1973).

A method of the left ventricular end-diastolic volume (EDV) determination is described. The method is based on the wash-out rate precordial recording of a solution of ^{133}Xe injected through a catheter into the left ventricle. In model experiments the variance of the results averaged 6.07% with some tendency to underestimate, probably due to inhomogeneous mixing. Further, the method was tried in 15 intact dogs; the variance of repeated measurements averaged 10.3%. The mean EDV was 24.5 ± 2.4 ml (S. E.)/10 kg of body weight and the SV/EDV × 100 ratio averaged 51.9% ± 4.0 (S. E.). Finally, the method was tested in six healthy subjects. The variance of repeated measurements was 7.36% in average; the mean EDV expressed in ml/m^2 BSA was 79.7 ± 5.7 (S. E.), and the ratio of SV/EDV × 100 averaged 54.9% 2.8 (S. E.). The findings of EDV in dogs and humans agree closely with the data published in the literature. The advantage of our method using the wash-out of ^{133}Xe and its precordial detection consists in the possibility of frequent repetitive measurements at various conditions. Some questions are further discussed concerning the homogeneity of indicator mixing with blood and both the advantages and drawbacks of the angiocardiographic and thermodilution methods. (auth)

2970 COMPARISON OF STANDARD CAROTIDOGRAPHY, HEMISPHERIC SCINTIGRAPHY (WITH MAAI-131) AND REGIONAL BLOOD FLOW MEASUREMENTS (WITH ^{133}Xe) IN BRAIN VASCULAR PATIENTS. Blandino, G.; Bonanno, N.; Bonavita, V.; Conforti, P.; Meduri, M. (Univ. Messina, Italy). J. Nucl. Biol. Med.; 17: No. 2, 58-63(1973).

Paradigmatic data obtained by a clinical, carotidographic, scintigraphic, and fluximetric study of eight patients who suffered a cerebral ictus 6 to 120 days before hospitalization are summarized. The association of the three above mentioned techniques (standard carotidography, scintigraphy with macroaggregates of iodinated serum albumin, and measurement of regional blood flow with intrarterial ^{133}Xe) has allowed a definitely better knowledge of hemispheric circulation. (auth)

2971 ^{131}I-HSA CISTERNOGRAPHY AND ^{131}I-HSA TRANSFER FROM CSF TO BLOOD IN NORMAL PRESSURE HYDROCEPHALUS. Galli, G.; Troncone, L.; De Rossi, G. (Univ. Cattolica S. Coure, Rome). J. Nucl. Biol. Med.; 17: No. 2, 64-70(1973).

Experience of isotope cisternography with ^{131}I-HSA in normal pressure hydrocephalus is reported. The results lead to the following considerations: The most characteristic cisternographic pattern of normal pressure hydrocephalus (determined by ventricular filling in the absence of demonstration of CSF pathways, no activity over the convexities) is not the only pattern existing. Some other pictures likely to be found where ventricular filling is associated with activity in the cisterns and through the cortical subarachnoid channels, sometimes reaching the convexities. All the patterns examined, though morphologically different, seemed to be related by a common dynamic feature, consisting in delayed diffusion and reabsorption of the isotope which tends to have a prolonged retention in the liquoral spaces. The examination of the plasmatic levels of the ^{131}I-HSA supports these data; in blood samples examined from the first to the 48th hr during isotope cisternography, the authors observed, in normal pressure hydrocephalus, a plasmatic concentration of ^{131}I-HSA 30 to 50% lower than in normal cases. The analysis of the curve of blood concentration of ^{131}I-HSA provides useful information as far as shunting and post-operative prognosis are concerned. (auth)

2972 BONE SCINTIPHOTOGRAPHIC EXAMINATION WITH ^{99m}Tc-TIN-PYROPHOSPHATE. Ferlin, G. (Hospital, Belluno, Italy). J. Nucl. Biol. Med.; 17: No. 2, 71-78(1973).

Skeletal scintiphotographic examination can be performed employing ^{99m}Tc-Pyrophosphate. This is a radiocomplex that allows some obstacles found by using the osteotropic radionuclides so far available for bone scanning (i.e., ^{85}Sr, ^{87m}Sr, ^{18}F) to be overcome. This compound can be administered at high dose, so that its concentration corresponding to the skeletal lesions is considerable. Therefore these lesions can be made visible, well outlined, and different from the structures of normal uptake, by using scintigraphy and much more gamma-camera, especially with a high-resolution collimator. Some patients bearing metastatic lesions were investigated and the compound, labeled single steep with radio Tc, has shown areas of accumulation in radiologically undamaged regions. (auth)

2973 POSSIBILITIES OF MEASURING THE PERFUSION OF HEART MUSCULATURE ON MAN BY NUCLEAR METHODS. Horvath, M. (Allami Szivkorhaz, Balatonfuered, Hungary); Ludvigh, K.; Fuest, L.; Lengyel, T.; Szirtes, L. Izotoptechnika; 16: No. 7-8, 482-487(1973). (In Hungarian).

Metrological, physiological, and clinical aspects of results obtained with ^{84}Rb and ^{86}Rb are reported. (auth)

2974 COMPARATIVE BRAIN SCINTIGRAPHIC EXAMINATIONS BY MEANS OF RADIOACTIVE INDIUM (^{113}In-EDTA) AND SAMARIUM (^{153}Sm-DTPA). Tarjan, G. (Orszagos Onkologiai Intezet, Budapest); Pal, I.; Karika, Z.; Fuezy, M.; Szentessyne, S. I. Izotoptechnika; 16: No. 7-8, 400-445(1973). (In Hungarian).

Superficial, smaller tumors are detected by ^{153}Sm-DTPA better than by ^{113}In-EDTA. The samarium compound is more suitable to gamma-camera exposures, but its γ radiation increases the radiation burden of patients, therefore it has advantages at places where nuclidic cows are hardly obtainable and used. (auth)

2975 INVESTIGATION ON THE DYNAMICS OF ^{169}Yb-EDTA IN KIDNEYS WITH GAMMA-CAMERA. Molnar, G. (Semmelweis Orvostudomanyi Egyetem III. sz. Belklinika, Budapest); Przedlacki, J.; Pal, I. Izotoptechnika; 16: No. 7-8, 446-450(1973). (In Hungarian).

For the calculation of glomerular filtration the velocity obtained an hour after isotope introduction is recommended. During this hour, important dynamic processes take place. With the method, the pathologic change in urinary output system (hydronephrosis, reflux) and the main transit time of isotope through the kidney parenchyma could be determined. (auth)

2976 APPLICATION OF RADIOACTIVE SAMARIUM COMPLEX (^{153}Sm-EDTA) IN THE SCINTIGRAPHY OF BONES. Karika, Z. (Orszagos Onkologiai Intezet, Budapest); Pal, I.; Tarjan, G.; Fuezy, M.; Nyul, T. P. Izotoptechnika; 16: No. 7-8, 460-464(1973). (In Hungarian).

The low price, simply preparable complex has not any toxic effects. Its well detectable γ radiation gives 60% lower burden to the patient than the ^{85}Sr. Owing to the burden from its β radiation and its low half life, the complex could be used only in the vicinity of nuclear reactor. (auth)

2977 SCINTIGRAPHY OF SALIVARY GLANDS BY MEANS OF TECHNETIUM-99m PERTECHNETATES. Haisova, L.; Krajska, V. (Charles Univ., Prague). Cesk. Stomatol.; 73: 169-176(1973). (In Czech).

Scintigraphic examination of great salivary glands by means of technetium after intravenous administration is reported. A scintillation camera, with one hole collimator and a 4096 channel analyzer, are used for detection. Documentation of scintigrams, especially those concerning inflammatory illnesses and tumors, is attached. The method is evaluated. (auth)

2978 DISTRIBUTION OF AUSTRALIA ANTIGEN AND ANTI-AUSTRALIA ANTIGEN ANTIBODY IN FAMILY DONORS BY SOLID PHASE RADIOIMMUNOASSAY. Ishii, R.; Hirano, T. (Keio Univ., Tokyo). Nippon Yuketsu Gakkai Zasshi; 19: No. 3, 89-93(Mar 1973). (In Japanese).

The distribution of Australia antigen (Au-ag) and the antibody towards the antigen (Au-ab) in family donors in Blood Transfusion Center, School of Medicine, Keio University, was studied by using solid-phase radioimmunoassay techniques. Au-ag was detected in 5.9% of the tested donors, and Au-ab was detected in 23%. No relationship among the value estimated of Au-ag, serum glutamic oxaloacetic transaminase (SGOT) and serum glutamic pyruvic transaminase (SGPT) in donors could be found. (auth)

2979 SOLID PHASE RADIOIMMUNOASSAY OF AUSTRALIA ANTIGEN AND ANTIBODY IN HUMAN PLASMA DERIVATIVES. Kazahaya, Y.; Naito, R. (Green Cross Corp., Osaka). Nippon Yuketsu Gakkai Zasshi; 19: No. 3, 82-88(Mar 1973). (In Japanese).

Human plasma fraction derivatives, Plasmanate (5% plasma protein solution) and globulin (15%), were made from 2 kinds of human plasma pools proven either positive or negative toward Au-antigen by immunoelectrosynelesis technique (IES). Both plasma pools and their products were quantitatively measured for Au-antigen and -antibody by solid-phase radioimmunoassay. While Au-antigen-positive plasma manifested 10^4 of Au-antigen concentration, derived Plasmanate and ISG preparations showed the titer of 10^3 and 10^1 respectively. While Au-antigen-negative plasma manifested 10^1 of Au-antigen, derived Plasmanate and ISG showed the titer smaller than 10^0. There was no difference in the antibody-binding ability of Au-antigen present in Plasmanate (Au-antigen positive origin) before and after heat-treatment at 60°C for 10 hours. Au-antibody was not found in Plasmanate. Au-antibody in the globulin preparation from Au-antigen negative plasma was found higher than that from Au-antigen positive plasma. (auth)

2980 COMPARISON OF HUMAN CHORIONIC SOMATOMAMMOTROPIN (HCS) STANDARDS FOR RADIOIMMUNOASSAY. Cocola, F.; Genazzani, A. R.; Neri, P. (Research Centre, Siena, Italy). J. Nucl. Biol. Med.; 17: No. 1, 22-24(1973).

A comparison was made between four commercially available HCS standards for radioimmunoassay, an interim standard from the Division of Biological Standards of the Medical Research Council, and a new preparation from our laboratories. Many differences are found between the various HCS preparations tested, and this may be one reason for the discrepancies found in absolute HCS plasma levels reported by different authors. The new Sclavo preparation seems to be the best, and its use is proposed as a new standard for radioimmunoassay. (auth)

2981 RADIOIMMUNOASSAY OF PROSTAGLANDIN $F_{2\alpha}$ IN UNEXTRACTED HUMAN PLASMA. Patrono, C. (Catholic Univ. of the Sacred Heart, Rome). J. Nucl. Biol. Med.; 17: No. 1, 25-29(1973).

A highly sensitive radioimmunoassay for endogenous human plasma prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) was developed using a guinea-pig antiserum to $PGF_{2\alpha}$-rabbit serum albumin conjugate. Sensitivity is better than 5 pg per ml. Of the known prostaglandins tested, only $PGF_{2\alpha}$ interacts appreciably with the antiserum. 13,14-Dihydro-$PGF_{2\alpha}$ and arachidonic acid show less than 0.1% cross-reactivity in this system. Plasma $PGF_{2\alpha}$ and standard $PGF_{2\alpha}$ show parallel inhibition curves against ^3H-$PGF_{2\alpha}$. The concentration of $PGF_{2\alpha}$ in the unextracted peripheral plasma of normal men and nonpregnant women was found to be consistently lower than 50 pg per ml. Slightly higher levels were found in pregnant women, while markedly elevated concentrations were measured at the peak of spontaneous uterine contractions and in a small group of cirrhotic patients. The possible sources of discrepancy among reported values of endogenous plasma $PGF_{2\alpha}$ are briefly discussed. (auth)

2982 NEW RADIOIMMUNOASSAY TECHNIQUE USING SECOND ANTIBODY TO SOLID PHASE APPLIED TO ASSAYS OF HUMAN CHORIONIC SOMATOMAMMOTROPIN. Cocola, F.; Genazzani, A. R.; Neri, P. (Research Centre, Siena, Italy). J. Nucl. Biol. Med.; 17: No. 1, 14-21(1973).

A modification of the double antibody method for the radioimmunoassay of Human Chorionic-Somatomammotropin (HCS) is proposed. Rabbit antibodies raised against goat gamma globulin are coated on polystyrene tubes under suitable conditions, to separate the anti-HCS - HCS complex from the test mixture. Thus the specific antibody and the sample to be tested, or the standard hormone are placed successively in the coated tubes. After incubation at 37°C for four hours, the labeled hormone is added. This is followed by an additional incubation at 37°C for fourteen hours. The precision and sensitivity of the method, and the good agreement with results obtained by the usual double antibody system, indicate that the Double Antibody-Solid Phase Radioimmunoassay (DASP-RIA) is a valuable improvement in the clinical assay of HCS, and suitable for wider application. (auth)

2983 INTESTINAL ABSORPTION OF RADIOACTIVE VITAMIN B_{12}: A COMPARISON OF PLASMA, FAECAL, AND URINARY TESTS. Mathan, V. I.; Swarnabi, S.; Baker, S. J. (Christian Medical Coll. Hospital, Vellore, India). Indian J. Med. Res.; 61: No. 5, 714-723(May 1973).

In order to assess the usefulness of plasma radioactivity measurements in determining the normality or otherwise of vitamin B_{12} absorption, a comparison was carried out in 55 individuals, between the plasma measurement and the faecal balance on 110 occasions, and between the plasma measurement and the Schilling test on 55 occasions. Plasma measurements provided 3% of false normal results, faecal balance studies 5% of false normal results and the Schilling test 16% of false low results. The measurement of rise in plasma radioactivity 8 h. after the test dose is an easy test to carry out, demands minimal cooperation from the patient, requires least time of patient follow up and is at least as reliable as the faecal balance performed under ideal conditions. It is, therefore, the best test of ileal function for field population surveys. (auth)

2984 PRODUCTION OF ANTISERUM TO LH-RELEASING HORMONE (LH–RH) ASSOCIATED WITH GONADAL ATROPHY IN RABBITS: DEVELOPMENT OF RADIOIMMUNOASSAYS FOR LH–RH. Arimura, A.; Sato, H.; Kumasaka, T.; Worobec, R. B. Debeljuk, L.; Dunn, J.; Schally, A. V. (Tulane Univ., New Orleans). Endocrinology; 93: No. 5, 1092-1103(Nov 1973).

Repeated injections of synthetic LH–RH decapeptide, adsorbed on polyvinylpyrrolidone and emulsified with complete Freund's adjuvant, resulted in the production of a specific antiserum to LH–RH in two of three rabbits. The animals that produced this antiserum showed a reduction of pituitary LH content and marked atrophy of the testes. The antiserum-antibody complex was detected by the complement fixation test. The antiserum was capable of binding ^{125}I-labeled LH–RH. After iodination of LH–RH (using ^{125}I and either the chloramine T or lactoperoxidase method) separation of the iodination products on CMC yielded three main peaks of radioactivity: The first was free iodide, the second was labeled peptide with low immunoreactivity, and the third was immunoreactive peptide. This 3rd peak consisted of two or three subpeaks; the leading subpeak(s) were more readily bound by antiserum than the trailing one(s). Binding of these fractions to antiserum was increased in the presence of small amounts of unlabeled LH–RH (a phenomenon called paradoxical binding or hock effect) but inhibited by larger amounts. Both the augmentation and the inhibition effects were dose-related, allowing the development of two different radioimmunoassay (RIA) systems for LH–RH. An ordinary (competitive) type of RIA was developed in which a small amount (0.31 ng/assay tube) of unlabeled LH–RH was added to the labeled peptide. This saturated the antiserum's capacity for paradoxical binding, so that further addition of LH–RH (from 0.04 to 2.5 ng/tube) inhibited binding of labeled LH–RH. The assay developed using paradoxical binding omitted the premixing of labeled and unlabeled LH–RH; in this assay addition of very small amounts (0.5 to 310 pg) of unlabeled LH–RH to the assay tubes increased the amount of label bound to antiserum and allowed construction of a parabolic curve of positive slope when B/T was plotted against arithmetic dose. The assays seem to be highly specific for LH–RH although both polymers and degradation products of LH–RH appeared to have some immunoreactivity. (auth)

2985 COMPUTATION OF PARAMETERS IN ISOTOPIC TRACER SYSTEM NOT IN A STEADY-STATE. Ottaway, J. H.; Mowbray, J. (Univ. of Edinburgh). Eur. J. Biochem.; 36: No. 2, 380-384(1973).

Methods of computing estimates of the variable parameters of tracer kinetic experiment in which the chemical pools were not all in a steady-state, by means of a function minimisation (optimisation) program coupled to a numerical integration procedure, are discussed. It is shown that if the transport rates depend nonlinearly on the concentrations of chemicals, or are independent of their concentrations, the rate constants (fractional turnover rates) of both chemical and tracer compartments may vary with the concentrations of the chemicals to which they refer, and this dependence may show up in the experimental record as a time-dependence. This variation has nothing to do with changes in the values of the underlying enzyme or permease parameters. Empirical methods of searching for such time- or substrate-dependence are discussed. It is also demonstrated that when tracer movements are formulated in terms of the total radioactivities and rate constants (dimensions, min^{-1}), a parallel formulation of the chemical fluxes should be processed, since the formulation of the tracer in terms of total radioactivities does not specify mathematically any constancy of the chemical pools, even where it exists. Failure to take this precaution may lead to very unsatisfactory estimates of the chemical fluxes. (GE)

2986 RADIONUCLIDE DEMONSTRATION OF TRAUMATIC ARTERIAL INJURY. Diamond, A. B.; Meng, C. H.; Wolanske, A. C.; Freeman, L. M. (Yeshiva Univ., New York). Radiology; 109: No. 3, 623-626(Dec 1973).

Experience with the radionuclide assessment of arterial trauma in six patients is reviewed. Three cases are presented in detail. Vascular obstruction, laceration, and pseudoaneurysm formation were demonstrated using currently available rapid scintiphotographic techniques. It is suggested that such studies be used as the initial procedure in patients with suspected vascular injuries. (auth)

MATERIALS

2987 CONFERENCE ON STRESS AND STRAIN IN ENGINEERING, BRISBANE, AUSTRALIA, AUGUST 23–24, 1973. Sydney; Institution of Engineers (1973). 259p.

Thirty-seven papers were presented at the conference. A separate abstract was prepared for each of three papers selected as in-scope for NSA. Papers for which no abstracts were prepared are concerned with safety factors, stress, bending, strain, fatigue, fracture, materials testing, shear, compression, deformation, cracking, tension, and transducers. (JRD)

For abstracts of individual papers see: 2595, 3004, and 3040.

2988 NATIONAL PHYSICAL LABORATORY: MATERIALS GROUP RESEARCH, 1972. London; Her Majesty's Stationery Office (1973). 153p. pounds 1.20.

Work for the period October 1969 to October 1972 is reported. It includes: national reference standards for physical chemistry units, methods for measurement of physicochemical properties, engineering specifications for materials, and engineering properties of materials. The work is reported under the subheadings Chemical Standards, Inorganic and Metallic Structure, and Materials Applications. (DLC)

Ceramics and Cermets

Refer also to abstracts 2469, 2493, 2564, 3045, 3097, 3109, 4460–4465, 4470, 4471, 4546, 4713, 4733, 4752, and 4753.

2989 (CONF-730938-1) PLATE-SHAPE VOIDS IN NEUTRON-IRRADIATED BORON CARBIDE. Ashbee, K. H. G.; DuBose, C. K. H. (Bristol Univ. (UK). H. H. Wills Physics Lab.; Oak Ridge National Lab., Tenn. (USA)). [nd]. 11p. Dep. NTIS $3.00.

From symposium on pore structures and properties of materials; Prague, Czechoslovakia (18 Sep 1973).

Several processes are known to produce lattice vacancies in sufficient excess of the thermal equilibrium concentration that they precipitate out as voids. In the case of certain nuclear transmutations, a solid solution of gas is simultaneously produced at a concentration corresponding to a high equilibrium pressure and, if this gas diffuses into the voids, the equilibrium shape for the void is a thin flat cavity. Transmission electron microscopy was used to examine both the nucleation of such voids in neutron-irradiated boron carbide and their transformation to more compact shapes during fission gas release. (auth)

2990 (CONF-730942-, pp vp Paper D 4/2) COMPLETE CHARACTERIZATION OF THE MECHANICAL PROPERTIES OF REACTOR GRADE GRAPHITE. Strauss, A. M. (Univ. of Cincinnati). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The mechanical properties of graphite are modeled over the entire range of conditions usually encountered in nuclear engineering practice. First, the low (room) temperature response is considered by means of a strain-rate independent model. Next, the high temperature mechanical properties of reactor grade graphite are described by means of a viscoplastic model which allows for permanent set while giving an adequate description of creep and stress-relaxation effects. Finally, a material model for the ageing of the material is developed. 6 references. (auth)

2991 (CONF-731104-7) MAGNETICALLY INDUCED LATTICE DISTORTIONS IN THE NEPTUNIUM MONOPNICTIDES. Mueller, M. H.; Lander, G. H.; Knott, H. W.; Reddy, J. F. (Argonne National Lab., Ill. (USA)). 1973. 7p. Dep. NTIS $3.00.

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973).

The lattice parameters of the neptunium monopnictides (NaCl crystal structure) were measured between 5 and 300°K by x-ray diffraction. NpN becomes ferromagnetic at 87°K. At T_C a rhombohedral distortion, which indicates that the $\langle 111 \rangle$ is the easy axis, is observed. At 5°K, the rhombohedral angle is $60.46 \pm 0.02°$. NpP exhibits a tetragonal distortion at 74°K, at which temperature the antiferromagnetic 3+, 3− structure becomes commensurate with the lattice. At 5°K, $c/a = 0.9958 \pm 2$. NpAs becomes tetragonal at $T_N = 175°K$ when the material has a 4+, 4− structure. However, NpAs returns to being a cubic at 142°K at which temperature the magnetic structure is the simple ± (type I) configuration. The "return" to cubic is first order; the volume of the unit cell expands by 0.23%. NpSb, which orders antiferromagnetically at 207°K with the type I structure, remains cubic in the ordered regime. (auth)

2992 (COO-1441-23) STUDY OF THE DEFECT STRUCTURE OF "PURE" AND DOPED NONSTOICHIOMETRIC CeO_2. Progress Report, January 1, 1973–December 31, 1973. Blumenthal, R. N. (Marquette Univ., Milwaukee, Wis. (USA). Coll. of Engineering). 1973. Contract AT(11-1)-1441. 27p. Dep. NTIS $3.50.

The temperature and compositional dependence of the electrical conductivity of CeO_{2-x} (i.e. $\sigma = \sigma(T,x)$) was determined by combining conductivity ($\sigma = \sigma(P_{O_2},T)$) and thermodynamic ($x = x(P_{O_2},T)$) data. In the temperature range 750 to 1500°C, $\sigma = 415 \times e^{-Q/kT}$, where Q is a function of x. This expression was rationalized in terms of the following simple relations for the electron concentration $n_{Ce'_{Ce}} = (8x/a_0^3)$ and the electron mobility $\mu = 5.3 \times 10^{-2} e^{-Q/kT}$, where μ_0 is independent of x, Q is independent of x from $10^{-3} < x < 10^{-2}$, and Q increases with x from $10^{-2} < x < 0.2$. Conductivity measurements on SrO-doped CeO_2, between .1 and 7 mole % SrO, show that the isothermal dependence of σ on P_{O_2} is similar to previously reported behavior of CaO-doped CeO_2. The mobility of oxygen vacancies appears to be larger for SrO-doped CeO_2. An electrochemical cell technique was used to measure the ionic transference number, t_i, of CeO_{2-x} as a function of temperature (590 to 1000°C) and oxygen partial 1 to 10^{-22} atm. The ionic transference number is controlled by impurities in the high oxygen pressure region. At low oxygen pressures, t_i is small. The electrical conduction in this region is controlled by the nonstoichiometric defects and is predominantly electronic. Using the value of $t_i \simeq 0.05$ an estimate of the diffusion coefficient for doubly ionized oxygen vacancies, $D_{V_O^{\cdot\cdot}} \simeq 3.5 \times 10^{-5}$ cm²/sec at 1000°C was calculated by combining recently obtained thermodynamic and conductivity data with the Nernst–Einstein relation. Thermogravimetric measurements were performed on CaO-doped CeO_{2-x} (i.e. $Ce_{1-y}Ca_yO_{2-y-x}$). $x = x(T,P_{O_2})_y$ was determined for values of $y = 0.01$, 0.07, and 0.14. The thermodynamic quantities $\Delta\bar{H}_{O_2}$ and $\Delta\bar{S}_{O_2}$ were calculated from these data. Near stoichiometry, the variation of $\Delta\bar{S}_{O_2}$ with x is consistent with a defect model involving randomly distributed doubly ionized oxygen vacancies and electrons localized on normal cerium sites. $\Delta\bar{H}_{O_2}$ is essentially a constant in this region, but increases with increasing CaO content. (auth)

2993 (GULF-GA-A-12051) MECHANICAL DESIGN OF TRISO COATED PARTICLE FUELS FOR THE LARGE HTGR. Gulden, T. D.; Smith, C. L.; Harmon, D. P.; Hudritsch, W. W. (Gulf General Atomic Co., San Diego, Calif. (USA)). 1 Jul 1972. Contract AT(04-3)-167. 23p. (CONF-720420-11). Dep. NTIS $3.25.

From conference on reactor materials performance; Richland, Washington, USA (24 Apr 1972).

The performance of TRISO-coated carbide fissile particles of the type to be used in the large HTGR correlates well with statistically based calculations of stresses in the SiC coating. Three coated-particle batches containing a total of nearly 10^4 individual coated particles showed insignificant coating failure ($\leq 0.2\%$) after exposure to essentially the most severe combined conditions of fast neutron exposure, burnup, and temperature to be experienced by fuel in a large HTGR. This high reliability derives from the fact that less than 1% of the particles in each batch had SiC tensile stresses greater than 30,000 psi, while the SiC layer in about 80% of the coated particles in each batch remained in compression throughout life. Two additional experimental batches of TRISO-coated carbide fissile particles had thinner coatings that resulted in higher mean SiC stresses in each batch and in probabilities of SiC coating stresses greater than 30,000 psi of 3.5% and 8.5%. In comparison, the observed incidence of coating failure during irradiation to full design exposures was about 4% in both cases. These results provide further confirmation of the value of coated-particle irradiation experiments and emphasize the importance of a statistical approach to coated-particle design. (auth)

2994 (GULF-GA-A-12596) IRRADIATION TESTING IN THE DEVELOPMENT OF FUEL ELEMENTS FOR THE GAS-COOLED FAST BREEDER REACTOR. Lindgren, J. R.; Campana, R. J.; Langer, S.; Weinberg, A. F.; Simon, R. H.; Longest, A. W.; Strain, R. (Gulf General Atomic Co., San Diego, Calif. (USA); Oak Ridge National Lab., Tenn. (USA); Argonne National Lab., Ill. (USA)). 30 Apr 1973. Contract AT(04-3)-167. 16p. (CONF-730726-4). Dep. NTIS $3.00.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

Results of irradiation testing of fuel rods for the Gas-cooled Fast Breeder Reactor (GCFR) are presented. It was found that under GCFR conditions volatile fission products were not observed beyond the fuel end of the blanket region in the GB-9 rod, which operated with no simulation of a cladding leak. This means that for normal operation up to the maximum burnup maintained in the GB-9 rod, i.e., 54,000 MWd/t, the charcoal trap was not required to limit transport of volatile fission products out of the fuel rod. No significant dimensional change was observed for the fuel rod irradiated to a burnup of 54,000 MWd/t. Attack of the cladding by fuel or fission products is in agreement with that observed in sealed rods tested under the LMFBR program. The observed gaseous fission-product releases and transport rates under steady-state conditions have verified the models being employed for systems analysis. The behavior of the gaseous fission products during transients of temperature, power, and pressure was in agreement with analytical predictions. Solid-state migration and gas-phase interdiffusion limit the rate of the release of gaseous fission products during normal operation. However, when a simulated leak is introduced, convective transport becomes dominant. The delay of gaseous fission products by the rod charcoal traps was as predicted over a temperature range simulating both normal and off-design GCFR operation. (JRD)

2995 (HEDL-TME-73-38) WDC-1-1 INSTRUMENTED IRRADIATION OF BORON CARBIDE IN A SPECTRUM-HARDENED ETR FLUX. Pitner, A. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Apr 1973. Contract AT(45-1)-2170. 45p. AT.

Boron carbide pellets were irradiated in a spectrum-hardened ETR flux at temperatures of 1220 to 1620°F up to maximum specimen-averaged exposures of 38×10^{20} captures/cm^3. Material variables included pellet density (75 to 99% T. D.) and stoichiometry (B : C = 3.8 to 4.1). Gas release and irradiation temperature were continuously monitored during the irradiation. Results are reported for boron carbide structural degradation, helium release, and interaction with Type 316 stainless steel. (auth)

2996 (IAEA-143(Vol. 1), pp 177-187) PROGRESS ON FABRICATION TECHNIQUES OF PLUTONIUM FUEL. Part II. Coated Particles. Vangeel, J. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium); Bairiot, H. 1972.

From panel on plutonium recycling in thermal power reactors; Vienna, Austria (21 Jun 1971).

Coated particles with a kernel containing plutonium are discussed. The objective of a high burnup, e.g., 600,000 MWd/t corresponding to 95% depletion, requires the incorporation of adequate voidage within the coating layers. This voidage can be incorporated in the kernel by diluting the plutonium with an inert material (graphite was chosen for this purpose) or by concentrating the plutonium into a small kernel coated with a thick buffer layer. The fuels have been irradiated up to extreme burnups (600,000 MWd/t up to 1200°C) and temperature conditions (1850°C up to 200,000 MWd/t). It should, however, be mentioned that unstabilized kernels are subject to fuel diffusion through the inner PyC layers, but this diffusion does not appear to harm the SiC layer. (auth)

2997 (LA-UR-73-692) CHEMICAL VAPOR DEPOSITION OF ZrC IN SMALL-BORE CARBON-COMPOSITE TUBES. Wallace, T. C. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 18p. Dep. NTIS $3.00.

Process conditions are described for the chemical vapor deposition of ZrC from $ZrCl_4-CH_4-HCl-H_2-Ar$ vapor over the temperature range 1320 to 1775°K. From an analysis of the process conditions (initial composition of coating gas, axial temperature profile along the tubes, total pressure, and length of deposition time), the subsequent ZrC coat thickness profiles and thermodynamic data, an equation expressing the variation of the axial rate of ZrC deposition is derived. This expression can be used for the estimation of process conditions required to yield a specified ZrC coat profile. Variations of the chlorine and oxygen contents, lattice parameter, microstructure of the ZrC deposit and thermal expansion coefficient as a function of deposition temperature are described. (11 figures, 3 tables) (auth)

2998 (ORNL-tr-2719) CONTRIBUTION TO FLUIDIZED-BED COATING OF NUCLEAR FUEL PARTICLES. Haange, R.; Gyarmati, E.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). May 1973. Translated from Jul-946-RW. 88p. Dep. NTIS $6.50.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

In a fluidized bed of a conical 3-inch coating furnace, temperature gradients were studied along with zones of deposition and the composition of the gas mixture in and above the bed. Measurements using thermocouples as well as theoretical considerations are the basis of a model defining the temperature distribution in relation to the particles and the gas composition across the bed. Thermal equilibrium was found to exist between the incoming gas and the bed of particles beyond a short heating stage above the nozzle system. No significant axial temperature gradients were detected here; radial temperature gradients remain small (<20°C). Zones of deposition were defined by thickness measurements carried out on the pyrocarbon deposits obtained on small fixed rods mounted in the bed. Comparison of plasma-oxidized pyrocarbon deposits on particles and fixed rods demonstrates the strong influence of particle movement and gas velocity on the structure of the pyrocarbon. Gas was sampled in the reaction zone by a suction method using small graphite tubes. The samples were analyzed by gas chromatography and mass spectrometry. Gas analysis results compared with calculated gas composition at thermodynamic equilibrium indicate that the composition approaches that of equilibrium above the heating stage. (auth)

2999 (TRG-Report-2393) STUDY OF THE POTENTIAL LATTICE PARAMETER MEASUREMENTS FOR THE DETERMINATION OF COMPOSITION OF PLUTONIUM–URANIUM CARBONITRIDE SPECIMENS. Savage, D. J. (UKAEA Reactor Group, Dounreay. Dounreay Experimental Reactor Establishment). Jul 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

Plutonium uranium carbonitrides were prepared and characterized by chemical and x-ray analysis. The relationship between lattice parameter and composition is considered as the basis of an analytical technique for the determination of the composition of unknown specimens. Factors affecting the correlation are discussed. The measured lattice parameters are higher than the exactly linear relationship between the end members required by Vegards Law. The deviation from Vegards Law is not consistent, resulting in material of almost identical composition possessing significantly different lattice parameters. This means that the unambiguous determination of the composition of carbonitride from its lattice parameter is not feasible. (3 figures, 4 tables, 20 references) (auth)

3000 (WANL-TME-1433) MIXED-CARBIDE FUEL PARTICLE STUDY. Brizes, W.; Kirkhart, F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 May 1966. 17p. Dep. NTIS $3.00.

Declassified 29 Aug 1973.

Results of studies on properties of uncoated UC–ZrC particles are presented. Information is included on particle density, chemical composition, and size. Data and information are also included on hydrolysis, leaching, homogenization, and processing. (JRD)

3001 (WANL-TME-1630) HOT-PRESSED NIOBIUM CARBIDE–GRAPHITE COMPOSITES. Progress Report. Blay, J. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Jun 1967. Subcontract NP-1. 61p. Dep. NTIS $5.25.

Declassified 30 Aug 1973.

An investigation was conducted to determine the manufacturability of hot-pressed 75–25 wt% NbC–graphite composites. Commercially available and custom ground superfine carbide and graphite powder combinations were evaluated; the hot pressing operation was studied; and machining techniques were developed. The relationship of the physical properties of the starting powders to thermal and mechanical properties of the composites was studied. Room temperature and 2400°C tensile, compressive, and flexural strengths were determined; tensile creep at 2400°C and compressive deformation (creep) at 2200°C were studied; and thermal expansion and specific heat to 5000°F were determined. In addition, the effect of a post hot-pressing heat treatment was studied. Evaluation of results shows that equally dense, high strength composites can be obtained by hot-pressing large or small billets. For the composition studied, the resulting structure of the superfine carbide graphite powders was a weak carbide continuous phase in a dominant continuous graphite phase. The resulting structure from commercially available carbide/graphite powders was a dominant carbide network. Optimum mechanical properties were obtained both at room temperature and at high temperature, using normal commercially available high purity powders. Thermal properties do not appear to be dependent on the physical properties of the powders. A post hot-pressing high-temperature heat treatment is important in improving the dimensional stability of the billets. Ultrasonic material removal techniques developed for rough machining and diamond tooling developed for final machining provided an economical high production method for manufacturing composite hardware. (auth)

3002 (WANL-TME-1801) DEVELOPMENT OF A PROCESS TO LOWER THE THERMAL EXPANSION OF HOT-PRESSED

NIOBIUM–GRAPHITE COMPOSITES. Blay, J. S.; Ellenburg, G. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Aug 1968. Subcontract NP-1. 48p. Dep. NTIS $4.50.

Declassified 30 Aug 1973.

Recent analysis of the NERVA hot end support system revealed that the high with-grain (WG) thermal expansion and the high creep deformation of NRX-A6 NERVA-type 75 wt% niobium carbide – 25 wt% graphite hot pressed composite material may not be entirely satisfactory in future designs. Design requirements have shown the need for a better match between the normally high average coefficient of thermal expansion $(\overline{\alpha})$ of the composite material and the fueled graphite. A manufacturing engineering program was initiated to investigate methods for reducing the difference in the coefficient of thermal expansion (CTE) between the fuel and the carbide composite and, in addition, methods for reducing the creep rate. These objectives were targeted to be accomplished on 75–25 wt% composite material. It was demonstrated that the coefficient of thermal expansion can be reduced by about 50 percent of the difference between the coefficient for fueled graphite and that for the NRX-A6 type of composite material without compositional changes. In addition, by a slight modification of the carbide–graphite ratio, the process should permit the matching of the CTE of fueled graphite and composite material. Improvements can be accomplished by a compressive heat treatment process in which the billet is subjected to a laterally unrestrained axial compression at an elevated temperature. The process can be accelerated by the substitution of calcined-petroleum needle coke in place of the graphite flour. A reduction of approximately 50% of the difference between the NRX-A6 and fueled graphite CTEs was accomplished with a compressive heat treatment without a die at 2700°C and 2000 psi for 60 minutes. A further reduction of 10% was accomplished when these parameters were changed to 2500°C and 3000 psi for 120 minutes. In addition to the reduction in the CTE that can be accomplished by the inclusion of the compressive heat treatment and the use of coke as a carbon source, the creep rate of the material is significantly reduced from the former 3 to 8% to a new range of from 2 to 4%; WG flexural strength seems to be more uniform and generally higher than NRX-A6 material properties. It has been further concluded that this combination of process changes and, in particular, the compressive heat treatment also reduces the spread within a billet and from billet to billet. The experiments also predicted that the CTE of the fueled graphite might possibly be matched by changing the carbide/graphite composite composition ratio to 65–35 wt%. A process for accomplishing this consists of a compressive heat treatment cycle of 2500°C and 3000 psi for 120 minutes on the 65–35 wt% hot-pressed billet with a 50–50 ratio of –100 + 150 mesh and –150 + 320 mesh needle coke as the graphite source. (auth)

3003 (Y-1923) LENGTH AND STRAIN-RATE EFFECTS ON THE PROBABILITY OF FAILURE OF TWO BORON REINFORCING MONOFILAMENTS. Oakes, R. E. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). 29 Oct 1973. Contract W-7405-eng-26. 16p. Dep. NTIS $4.00.

Breaking-strength data from one-inch gage-length specimens and Weibull statistical techniques are used to characterize the probability of failure dependence on the length of brittle tungsten-core and carbon-core boron monofilaments. Experimental results, using longer-gage-section specimens, are in good agreement with the failure probability predicted by the Weibull function. Strain-rate effects on the probability of failure of both materials are investigated over the quasistatic range from 3.3×10^{-5} to 3.3×10^{1} sec^{-1}. Failure probability is shown to be independent of the strain rate for both materials. (auth)

3004 QUENCHING OF BERYLLIUM OXIDE SPHERES. Whatham, J. F. pp 205-210 of Conference on Stress and Strain in Engineering. Sydney; Institution of Engineers (1973).

From conference on stress and strain in engineering; Brisbane, Australia (23 Aug 1973).

A number of sintered ceramic BeO balls were heated and then quenched in fast-flowing CO_2 gas to determine the thermal stress which would crack similar balls containing a small amount of UO_2 fuel in the core of a prospective pebble-bed nuclear reactor. The stress to crack the average ball was determined using simplifying assumptions and the ratio to the bend strength of BeO calculated. This ratio between the thermal stress to crack a ball and the bend strength was assumed to apply to fueled as well as unfueled BeO balls at all temperatures and this enabled the heat output of the fuel balls in a reactor to be estimated. (auth)

3005 DISLOCATION UNPINNING IN SINGLE CRYSTALS OF CERAMIC OXIDES. Ritchie, I. G. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). (1973). vp.

From 5th international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

A counterbalanced reed pendulum was used to investigate amplitude-dependent damping at low frequencies in MgO and sapphire under strain. Fresh dislocations introduced into neutron-irradiated and unirradiated single crystals were shown to produce large amplitude-dependent effects. The shape of the damping vs amplitude curve is sensitive to vibration conditioning and varies markedly with temperature. The results were interpreted using the Blair, Hutchison, and Rogers theory for the thermally assisted unpinning of very long dislocation-loop lengths. In this theory a generalized pinning force was introduced into the Teutonico, Granato, and Luecke model; it was assumed that the dislocation loops are of equal length. Results for a given specimen are presented in a temperature-strain diagram which delineates five regions of different damping behavior. The binding energy between the pinning agent and dislocation, the dislocation loop length, and asymptotic behavior of the force law between dislocation and pinning agent are estimated from the results. (GE)

3006 ELASTIC PROPERTIES AND SUPERCONDUCTIVITY OF V_3Si AT HIGH PRESSURE. Carcia, P. F.; Barsch, G. R. (Pennsylvania State Univ., University Park). Phys. Status Solidi (b); 59: No. 2, 595-606(1 Oct 1973).

The pressure derivatives of the single-crystal elastic constants of V_3Si were measured at 77 and 298°K, and the pressure derivative of the shear modulus $c_s = (c_{11} - c_{12})/2$ was measured between 37 and 298°K. The V_3Si crystal was of the kind that undergoes the Batterman–Barrett low-temperature structural transformation. The results differ significantly from those for nontransforming V_3Si in that, for transforming crystals, $(\partial c_s/\partial p)_T$ shows a negative minimum at about 80°K and is positive below about 50°K. This is in semiquantitative agreement with the negative pressure coefficient for the structural transformation measured by Chu. From the elastic data the elastic Grüneisen parameters and the pressure coefficients $(\partial T_c/\partial p)$ of the superconducting transition temperature were calculated in the anisotropic Debye approximation. For nontransforming V_3Si the calculated value of $(\partial T_c/\partial p)$ shows the correct sign, but is two and one-half times larger than the experimental value. The calculated $(\partial T_c/\partial p)$ is for transforming V_3Si considerably smaller than for nontransforming samples. (auth)

3007 HEAT CAPACITY OF THORIUM NITRIDES FROM 450 TO 850°K. Ono, F.; Kanno, M.; Mukaibo, T. (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 7, 391-395(Jul 1973).

The thorium nitrides (ThN and Th_3N_4) were prepared by solid–gas reaction with thorium hydride and nitrogen. The heat capacity of these samples was measured from 450 to 850°K by a high-temperature double-adiabatic calorimeter and was determined as functions of temperature as follows: Th_3N_4: $C_p = 41.30 - 8.47 \times 10^{-3}\,T - 6.37 \times 10^{5}\,T^{-2}$, ThN: $C_p = 12.50 - 2.66 \times 10^{-3}\,T - 2.44 \times 10^{5}\,T^{-2}$. (auth)

3008 EFFECTS OF GAMMA IRRADIATION ON ULTRASONIC ATTENUATION IN QUARTZ AND TOURMALINE AT LOW TEMPERATURES. Thuraisingham, M. S. (Imperial Coll. of Science and Tech., London); Stephens, R. W. B. (1973). vp.

From 5th international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

Results of a study on the effects of gamma irradiation and annealing on the attenuation of hypersonic compressional waves in quartz and tourmaline crystals are reported. The defect concentration in the crystals was altered by successive doses of irradiation and subsequent annealing, and the effects of these changes on the ultrasonic attenuation were studied. The data relating to overall attenuation behavior is correlated with the attenuation theory of Silverman. (GE)

3009 OXYGEN INTERACTIONS BETWEEN SODIUM AND URANIUM–PLUTONIUM OXIDE FUEL. Smith, D. L. (Argonne National Lab., IL). Nucl. Technol.; 20: No. 3, 190-199(Dec 1973).

The oxygen concentration of sodium in equilibrium with uranium–25% plutonium oxide fuel was measured at temperatures of 650 to 900°C for fuels with oxygen-to-metal ratios of 1.90, 1.94, and 1.97. The oxygen concentration in sodium at the three-phase $Na-MO_{2-x}-Na_3MO_4$ (M = uranium plus plutonium) equilibrium has also been measured for the same temperature range. This three-phase equilibrium was established by reacting mixed-oxide fuel with sodium to which Na_2O had been added. The oxygen concentrations in sodium were determined by the vanadium-wire equilibration method. The oxygen concentration in sodium at the three-phase equilibrium varied from ~0.1 to 0.4 ppM in the temperature range investigated. Oxygen concentrations in EBR-II primary sodium, which have been measured by the same method, vary from 0.4 to 0.9 ppM oxygen depending on the cold-trap operation. These values indicate that the sodium–fuel reaction product, i.e., Na_3MO_4, is stable in sodium at the temperatures (<1000°C) and oxygen levels present in EBR-II. (auth)

3010 IMPROVED DIFFUSION WELDING TECHNIQUE FOR TD-NiCr SHEET. Holko, K. H. (Rohr Industries, Chula Vista, CA). Weld. J. (N.Y.); 52: No. 11, 515s-523s(Nov 1973).

An improved diffusion-welding technique was developed to join TD-NiCr sheet. Compared with results of previous work, this improved technique has the advantages of shorter welding time, lower welding temperature, lower welding pressure (in the most preferred form), and a simpler and more reproducible surface-preparation procedure. Weldments were made that had base metal creep-rupture shear strength at 1100°C of 20 MN/m^2. Specially processed (unrecrystallized) and commercial TD-NiCr were effectively welded using the improved welding technique. However, the specially processed material was preferred over the commercial material since the weld line could be eliminated, creep-rupture fracture of weldments took place in the base metal away from the weld line, and the creep-rupture shear strength of weldments was higher than that of welds made in commercial TD-NiCr. With the commercial TD-NiCr, a semi-continuous weld line resulted and creep-rupture shear fracture took place at this weld line indicating a plane of weakness. Specially processed material was also welded to commercial material with the improved technique. These welds looked very promising and performed similarly to the welds in specially processed material. Previous work resulted in the recommendation that a 600 grit sanded plus electropolished surface preparation be used prior to diffusion welding either specially processed or commercial TD-NiCr. (auth)

3011 INCREASE IN SURFACE-ACOUSTIC-WAVE VELOCITY PRODUCED BY ION IMPLANTATION IN QUARTZ. Hartemann, P.; Morizot, M. (Thomson-CSF, Orsay, France). Electron. Lett.; 9: No. 21, 497–498(18 Oct 1973).

An increase in the surface-acoustic-wave velocity, arising from surface-state modification, is reported for the first time. It was obtained by a 100-keV ion implantation on quartz substrates tested at a frequency of 180 MHz. $^1H^+$, $^4He^+$, $^7Li^+$, $^9Be^+$, $^{11}B^+$, and $^{40}Ar^+$ ions were used. The flux is about 10^{16} ions/cm^2, and the surface waves propagate faster on the implanted surface than on the unimplanted part, because a crystalline-to-amorphous transition is created by ion implantation. The greatest relative-velocity increase is measured using Li^+ and He^+ ion bombardment, and was found to be equal to 1.1% at 180 MHz. The insertion losses of the delay lines are not significantly changed by the implantation. A 1000 Å step height was measured at the boundary of the implanted surface, as a consequence of the increase in volume of the implanted part. (auth)

3012 PULSED FERROMAGNETIC NUCLEAR RESONANCE IN Co_3B AND Co_2B. Lemius, B. (Univ., Strasbourg). Compt. Rend., Ser. A, B; 277: No. 4, 111-113(23 Jul 1973). (In French).

The resonance of the ^{59}Co nucleus in the Co_3B and Co_2B intermetallic compounds was studied at 4.2 and 77°K using the spin echo method. Results show that the distribution of the hyperfine field near to the cobalt nucleus is extremely wide and complex (principally in Co_2B). This distribution varies considerably with temperature in Co_3B. (FR)

3013 THERMOPHYSICAL PROPERTIES RESEARCH LITERATURE RETRIEVAL GUIDE, SUPPLEMENT I, 1964–1970. Volume 1. Elements and Inorganic Compounds. Touloukian, Y. S. (ed.). New York; Plenum Publishing Corporation (1973). 526p.

The Thermophysical Properties Research Center published in 1967 a complementary work to their Data Tables Series. This was a three-book work reporting 33,700 references on seven thermophysical property groups and about 45,000 materials. The data covered published works from 1920 to 1964. Supplement I now reports an additional 26,000 references on sixteen thermophysical properties of 20,000 materials covering 1964 to 1971. An additional 9,000 synonyms and trade names are cross-referenced to assist the user in identifying the materials or substance of interest. The materials directory of Volume 1 of Supplement I covers nonspecific entries of Class 100 and elements and inorganic compounds of Classes 101 to 127. Papers published on thermal conductivity, accommodation coefficient, thermal contact resistance, thermal diffusivity, specific heat, viscosity, emittance, reflectance, absorptance, transmittance, absorptance to emittance ratio, Prandtl Number, diffusion coefficient, thermal linear expansion coefficient, thermal volumetric expansion coefficient, and surface tension properties are included. A bibliography and author index are listed. (MCW)

3014 THERMOPHYSICAL PROPERTIES RESEARCH LITERATURE RETRIEVAL GUIDE, SUPPLEMENT I, 1964–1970. Volume 3. Alloys, Intermetallic Compounds, and Cermets. Touloukian, Y. S. (ed.). New York; Plenum Publishing Corporation (1973). 332p.

The Thermophysical Properties Research Center published the Supplement I to their basic retrieval guide. The materials directory of Volume 3 of Supplement I covers most of the ferrous alloys and intermetallic compounds in the 300 Classes; most of the nonferrous alloys and intermetallic compounds in the 400 Classes; and cermets Class 561. Papers published on thermal conductivity, thermal diffusivity, specific heat, viscosity, emittance, reflectance, absorptance, transmittance, absorptance to emittance ratio, Prandtl Number, diffusion coefficient, thermal linear expansion coefficient, thermal volumetric expansion coefficient, and surface tension properties are included. A bibliography and author index are listed. (MCW)

3015 THERMOPHYSICAL PROPERTIES RESEARCH LITERATURE RETRIEVAL GUIDE, SUPPLEMENT I, 1964–1970. Volume 4. Oxide Mixtures and Minerals. Touloukian, Y. S. (ed.). New York; Plenum Publishing Corporation (1973). 228p.

The Thermophysical Properties Research Center published Supplement I to their basic retrieval guide. The materials directory of Volume 4 of Supplement I covers slags and scales, Class 501; ceramics, refractories, and metallic oxide mixtures, Class 504; glasses, Class 507; and minerals and soils, Class 521. Papers published on thermal conductivity, thermal contact resistance, thermal diffusivity, specific heat, viscosity, emittance, reflectance, absorptance, transmittance, absorptance to emittance ratio, diffusion coefficient, thermal linear expansion coefficient, thermal volumetric expansion coefficient, and surface tension properties are included. A bibliography and author index are listed. (MCW)

3016 THERMOPHYSICAL PROPERTIES RESEARCH LITERATURE RETRIEVAL GUIDE, SUPPLEMENT I, 1964–1970. Volume 6. Coatings, Systems, and Composites. Touloukian, Y. S. (ed.). New York; Plenum Publishing Corporation (1973). 244p.

The Thermophysical Properties Research Center published Supplement I to their basic retrieval guide. The materials directory of Volume 6 of Supplement I covers materials in Classes 526, 528, 531, 541, 551, 621, 651, and 661. Papers published on thermal conductivity, accommodation coefficient, thermal contact resistance, thermal diffusivity, specific heat, viscosity, emittance, reflectance, absorptance, transmittance, absorptance to emittance ratio, diffusion coefficient, thermal linear expansion coefficient, thermal volumetric expansion coefficient, and surface tension properties are included. A bibliography and author index are listed. (MCW)

3017 NOTE ON THE MAGNETIC STRUCTURE OF U_3P_4. Murasik, A. (Inst. of Nuclear Research, Warsaw); Ligenza, S.; Leciejewicz, J.; Troc, R. Phys. Status Solidi (a); 19: No. 1, K89-K91(16 Sep 1973).

Results of neutron-diffraction studies of U_3P_4 are reported. Several magnetic moment configurations were considered. It is concluded that noncollinear structures in U_3P_4, if they exist, are very complex. Single-crystal investigations appear to be necessary. (JRD)

3018 PHASE EQUILIBRIUM OF UO_{2+x}–MgO SYSTEM. Sugisaki, M.; Hirashima, K.; Yoshihara, S.; Oishi, Y. (Kyushu Univ., Fukuoka). J. Nucl. Sci. Technol. (Tokyo); 10: No. 6, 387–389(Jun 1973).

The variation with y of the lattice parameter of the fluorite structure of $Mg_yU_{1-y}O_{2+x}$ was studied using x-ray diffraction. Results show two phases, one cubic and the other orthorhombic. The two-phase region at low MgO contents consists of a U_3O_{8-z} phase and a cubic $Mg_yU_{1-y}O_{2+x}$ solid solution. Beyond 39 mole % MgO, the two-phase region consists of MgO and the cubic solid solution. The U_3O_{8-z} phase dissolved little MgO, while the solubility of MgO in UO_{2+x} is 39 mole % at 1200 to 1600°C. A phase diagram is included. (DLC)

3019 STIMULATED RADIATION OF Nd^{3+} IONS IN CRYSTALS IN THE TRANSITION $^4F_{3/2} \to {}^4I_{13/2}$. Aleksandrov, V. I.; Kaminskii, A. A.; Maksimova, G. V.; Prokhorov, A. M.; Sarkisov, S. E.; Sobol, A. A.; Tatarintsev, V. M. (Lebedev Inst. of Physics, Moscow). Dokl. Akad. Nauk SSSR; 211: No. 3, 567-570(21 Jul 1973). (In Russian).

Crystals of CaF_2-YF_3, $Ca_2Y_5F_{19}$, $Ca_5(PO_4)_3F$, $ZrO_2-Y_2O_3$, and $HfO_2-Y_2O_3$ containing Nd^{3+} were irradiated with 1.35-μ radiation. Data on the subject transition and luminescent spectra are presented. (auth)

3020 X-RAY DETERMINATION OF DEBYE TEMPERATURE OF POLYCRYSTALLINE NIOBIUM AND TANTALUM MONO-

CARBIDES. Krivy, I.; Sedivy, J. (Nuclear Research Inst., Prague). Phys. Status Solidi (a); 19: No. 1, 259–265(16 Sep 1973).

Lattice dynamics of nearly stoichiometric NbC and TaC phases was investigated using the Bragg-intensity measurements at two temperatures (110 and 300°K). The vibration amplitudes of metal atoms are shown to be smaller compared with those of carbon atoms, the differences $\sqrt{\overline{u^2_C}} - \sqrt{\overline{u^2_{Me}}}$ decrease with increasing temperature. The separation of the Debye-Waller factors of both components results in the following values of the Debye temperature: θ_{300}(NbC) = (654 ± 6)°K and θ_{300}(TaC) = (428 ± 8)°K. Using the common-amplitude approximation, values of (643 ± 6) and (430 ± 7)°K are found for NbC and TaC, respectively. The results obtained indicate isotropy of the carbide lattices with respect to thermal atomic vibrations over the range 110 to 300°K. (auth)

3021 OPTICAL PROPERTIES OF TANTALUM BORATE ($TaBO_4$), A COMPOUND WITH UNUSUAL COORDINATIONS. Blasse, G.; van den Heuvel, G. P. M. (Univ., Utrecht). Phys. Status Solidi (a); 19: No. 1, 111–117(16 Sep 1973).

Tantalum borate ($TaBO_4$) has the zircon structure with unusual coordination for the cations: Ta^{5+} in eight- and B^{3+} in four-coordination. The infrared and Raman spectrum is reported and discussed. The symmetrical and asymmetrical BO_4^{5-} valence stretching lies at much lower energy than usually observed in borates. A comparison with other compounds with zircon structure is made. $TaBO_4$ shows a bluish-white luminescence under ultraviolet excitation at temperatures below liquid N_2 temperature. The emission consists of at least two subbands. A comparison with $YTaO_4$ is made. (auth)

3022 TYPE-II DOMAINS IN FERROELECTRIC GADOLINIUM MOLYBDATE. Bohm, J.; Kuersten, H. D. (Zentralinstitut fuer Optik und Spektroskopie, Berlin). Phys. Status Solidi (a); 19: No. 1, 179–183(16 Sep 1973). (In German).

Etching (001)-faces of gadolinium molybdate (GMO) reveals new kinds of domains. They are created by a translation, that leaves the spontaneous polarization and the transition parameter invariant. The translation vector is a part of a lattice vector, similar to stacking faults. (auth)

3023 MOESSBAUER SPECTROMETRY OF THE ISOTOPE ^{170}Yb IN YbB_6 AND TmB_{12}. Gonzalez Jimenez, F. (CEN, Saclay, France); Imbert, P.; Achard, J. C.; Percheron, A. Phys. Status Solidi (a); 19: No. 1, 201–206(16 Sep 1973). (In French).

A narrow single-line Mössbauer source for ^{170}Yb, with a large Debye-Waller factor ($f_0 \approx 34\%$), is obtained by neutron irradiation of thulium dodecaboride. Ytterbium hexaboride exhibits a much lower f_0 factor ($f_0 \approx 10\%$) with an isomer shift characteristic of the 2+ oxidation state. (auth)

3024 VALIDITY OF RECENT ELECTRON MICROSCOPE OBSERVATIONS OF GADOLINIUM MONOXIDE AND A RELATED LOWER OXIDE. Curzon, A. E.; Chlebek, H. G. (Simon Fraser Univ., Burnaby, B. C.). Phys. Status Solidi (a); 19: No. 1, 207–211(16 Sep 1973).

Other workers have claimed that GdO is produced when the vapor of gadolinium metal is condensed on to NaCl at 550°C. It is pointed out that the films so produced are probably a face-centred-cubic form of gadolinium metal and that the superlattice that forms when the films are bombarded with an intense beam of electrons is not a reduced form of GdO, as has been suggested, but a higher oxide (probably a nonstoichiometric form of Gd_2O_3). When GdO made by vacuum distillation of a powder containing gadolinium metal and Gd_2O_3 is annealed by electron bombardment a superlattice develops which other workers claim is due to rhombohedral $GdO_{0.656}$. It is pointed out here that the published electron-diffraction patterns of this material are consistent with cubic symmetry and that all the diffraction spots may be indexed with a cubic unit cell. The fact that gadolinium may be oxidized to Gd_2O_3 by means of electron bombardment is used to support the view that electron bombardment of GdO should lead to the formation of a higher oxide and not to the proposed lower oxide $GdO_{0.656}$. (auth)

3025 ENERGY SPECTRUM OF THERMALLY STIMULATED EXOELECTRONS FROM BeO. Peterson, D. D. (Institut duer Strahlenschutz, Neuherber, Ger.). Phys. Status Solidi (a); 19: No. 1, K47–K50(16 Sep 1973).

The energy of thermally stimulated exoelectrons from irradiated BeO ceramic disks is reported. Brush thermalox 995, Berylco 1 (99.25% BeO), and Berylco 2 (96% BeO) were investigated. The maximum and mean energy values from Brush BeO are 1.5 and 0.5 eV, respectively, and are independent of the temperature position. These values are comparable with exoelectron energies found from other materials. On the other hand, the Berylco results reveal a completely different result. Curves are included representing retarding potential measurements taken at three different temperature regions in the double-peaked glow curve. The curves show that relatively high energy electrons are emitted from Berylco BeO. A curve is included which shows the energy spectrum to 16 eV, measured in the vicinity of the maximum of the weaker, low temperature glow peak (i.e. peak maximum at about 250°C). The results show an inverse correlation between the electron energy and the glow peak position. It is clear that the often suggested mechanisms based on, for example, exothermic chemical reactions at the surface, Auger-type emission, or the high-energy tail of the Maxwellian distribution cannot explain these high energies. The dipole layer model seems to best explain the high exoelectron energies from Berylco BeO. (JRD)

3026 SCIENCE OF CERAMICS. Volume 6. Proceedings of the Sixth International Conference Held at Baden Baden, Germany, November 14–18, 1971. Bad Honnef, Ger.; Deutsche Keramische Gesellschaft (1973). 392p. (In Several Languages). (CONF-711155-). DM 50.-.

Recent research on a wide range of ceramic materials from the traditional to the most advanced compositions was presented at the proceedings of the Sixth International Congress of Science of Ceramics. Eight papers dealt with the determination and importance of microstructure parameters; thirteen papers dealt with the relationships between ceramic microstructures and the properties of ceramic materials; and thirteen papers were presented on the influence of raw material properties and preparation, shaping, firing, and sintering on the formation of ceramic microstructures. (MCW)

3027 PREPARATION OF REFRACTORY FIBERS BY CHEMICAL CONVERSION METHOD. Economy, J.; Smith, W. D.; Lin, R. Y. (Carborundum Co., Niagara Falls, NY). Appl. Polym. Symp.; No. 21, 131–141(1973).

Preparation of refractory fibers by conventional fiber forming techniques is very difficult because of the high melting point and unfavorable melt rheology of most refractory materials. A new general approach for synthesis of such fibers was developed. The method involves converting a precursor fiber into a refractory fiber by chemical means. The conversion usually takes place via a series of heterogeneous reactions which are diffusion controlled. The practical and theoretical limitations of the chemical conversion method are discussed. The versatility of this approach is illustrated by a number of examples which include preparation of BN, TiN, NbN, B_4C, Mo_2C, and NbC fibers. (7 tables, 6 figures) (auth)

Metals and Alloys

Refer also to abstracts 4721, 4736–4739, 4745, 4747, 4751, 4767, and 4783.

3028 (UJV-2232-R) SODIUM LOOP FOR REACTOR MATERIALS. Sulc, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 23p. (In Czech). Dep. NTIS (U. S. Sales Only) $3.25.

The effects of radiation on materials for fast reactors are described. Of the two types of loops that can be used in a materials testing thermal reactor, each has its advantages and disadvantages. Evaluation of the whole radiation program by study of the materials for a fast reactor helps solve the problem of the type of loop that should be constructed. In each case of constructing a sodium loop for a materials testing reactor, a group of workers should be formed to evaluate this problem. As an illustration, the BR-2 sodium loop at Mol is being studied by 22 workers with regard to theoretical and experimental reactor physics, measuring equipment, construction, testing, and other phases of the project. (auth)

Corrosion and Erosion

Refer also to abstracts 4765, 4768, 4773, and 4777.

3029 (AECL-4589) EFFECT OF SURFACE FILMS ON THE INITIATION OF STRESS CORROSION CRACKING OF ZIRCALOY-2. Cox, B. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jun 1973. 24p. (CONF-730661-1). Dep. NTIS (U. S. Sales Only) $3.25.

From fifty sixth annual CIC meeting on the effects of surface films on the initiation of stress corrosion cracking of zircaloy-2; Montreal, Canada (4 Jun 1973).

In aqueous NaCl solution (with anodic polarization) at room temperature, iodine vapor (plus air) at 300°C, and fused nitrate/chloride (iodide) melts at 300°C, the first step in the degradation of the protective oxide is the growth of a film with abnormal morphology and structure. This film develops porosity which permits direct access of the environment to the metal, followed by subsurface pitting (in some environments). In fused nitrate/iodide at 300°C, such an abnormal film is not formed, and oxide growth continues until small cracks are generated by the total stress acting on the film. These cracks, and similar ones formed when preoxidized specimens are exposed to the other environments, permit access of the environment to the metal, and the formation of crack nuclei, without the intervention of suboxide pits. The participation of slip-steps in the conversion of pits (or oxide cracks) to propagating stress-corrosion cracks was not established positively. (12 figures, 20 references) (auth)

3030 (ANL-8015) GENERALIZED METHOD OF COMPUTING CARBON-DIFFUSION PROFILES IN AUSTENITIC STAINLESS STEELS EXPOSED TO A SODIUM ENVIRONMENT. Snyder, R. B.; Natesan, K.; Kassner, T. F. (Argonne National Lab., Ill. (USA)). Jun 1973. Contract W-31-109-eng-38. 70p. Dep. NTIS $5.45.

Numerous experimental observations on the carburization–decarburization behavior of austenitic stainless steels in high-temperature flowing sodium have been reported; however, quantitative predictions of carbon diffusion in the steels under specific environmental conditions have been difficult. A mathematical analysis for the process has been developed that incorporates (1) the thermodynamic and kinetic information for carbon in the alloys, (2) the thermal-mechanical treatment of the material (solution annealed versus cold worked) that influences the microstructure, and (3) the carbon concentration in sodium and its dependence on sodium-system parameters. Carbon concentration–distance profiles in Types 304 and 316 stainless steel were generated as a function of time, temperature, and carbon concentration in sodium and compared with experimental data. The analysis was used to evaluate the carburization–decarburization behavior of Type 316 stainless steel fuel cladding exposed to sodium and to develop carbon-diffusion profiles in Type 304 stainless steel intermediate-heat-exchanger piping upon exposure to primary- and secondary-system sodium for periods to 30 y. (auth)

3031 QUASI-EQUILIBRIUM APPROACH TO THE ZIRCONIUM–OXYGEN COMBUSTION PHENOMENA. Gupta, S. K.; Maloney, K. M. (General Electric Co., Cleveland). J. Appl. Phys.; 44: No. 7, 3339-3346(Jul 1973).

It is found, for pressures ~1 atm and above, that the residence time for molecular oxygen, in the gas-phase combustion region surrounding a 525-μ zirconium droplet, is of the same order of magnitude or greater than the mean dissociation time for molecular oxygen; therefore, the concentration of species are assumed to have their equilibrium values. The distribution of species over the reaction zone is calculated by means of free-energy minimization. Calculation of the existing equilibria, under known reaction conditions, illustrates the existence or nonexistence of condensed phases. The meanings of reactive collision probability, apparent over-all oxygen incorporation probability and minimum fractional surface oxygen incorporation, as related to droplet combustion, are discussed. Additionally, some methods by which the maximum combustion temperature of the Zr-oxygen system has been obtained are discussed. (auth)

3032 TRANSPORT AND DEPOSITION OF METALS IN SODIUM-STAINLESS STEEL SYSTEMS. I. Corrosion Product Distribution in a Natural Circulation Loop. Sagawa, N.; Iba, H.; Murata, T.; Kawahara, S. (Hitachi Ltd., Ibaraki, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 8, 458-469(Aug 1973).

Corrosion and mass transfer behavior of austenitic stainless steels in a natural-circulation sodium loop was studied over a temperature range from 630 to 230°C for a period of 2,000 h with the aid of tracer techniques. Changes with running time were observed in the metal concentrations in sodium by sampling and analyzing the sodium in the loop. The distributions of the corroded metals over various cross sections along the cooling tube were determined by analyses performed on samples of sodium, which had been obtained by quick solidification of the flowing sodium and dissection of the solidified sample. The distribution of radioisotopes, which had been leached into the sodium from irradiated stainless steel foils located in the hot sodium stream, was also measured. The changes of leaching rate with running time differed between those of the radioactive and the stable metals. Iron and cobalt deposit on the substrate material presumably by atomic diffusion across the sodium stream and by particle formation in the sodium stream prior to accumulation. Chromium, on the other hand, deposits on the substrate material presumably by formation of chemical compounds in the sodium stream prior to accumulation. The mechanisms of deposition of nickel and manganese could not be made clear. (auth)

3033 DETERMINATION OF DIFFUSION PARAMETERS OF AN ADSORBATE IN A METAL ADSORBENT (CARBON MONOXIDE IN TANTALUM) BY THE FLASH METHOD. Ustinov, Yu. K. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 10, 1701-1704(Apr 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 10, 2153-2157(Oct 1972).

The adsorption of carbon monoxide on tantalum by the flash method shows that an increase in adsorbent temperature during the flash leads first to solution of the adsorbate in the metal and then to desorption from the surface into the gas phase. This process cleans the tantalum surface and leads to diffusion of the dissolved material back to the surface. Outgassing of tantalum by a flash is treated as a sequential reaction: transfer of the material from the interior of the metal to its surface $M \xrightarrow{K_1} S$ and then from the surface to the gas phase $S \xrightarrow{K_2} G$ occur sequentially. When K_1 and K_2 are constant, there is an analytic relation between the amount of desorbed material and the desorption time (K_1/K_2 is the parameter), which accounts qualitatively for the features of the experimental desorption curves. (auth)

3034 POST-DISCHARGE EMISSION OF ELECTRONS FROM MOLYBDENUM AND BARIUM SURFACES FOLLOWING OXYGEN ABSORPTION. Tatarinova, N. V. (Inst. of Engineering Physics, Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 10, 1705-1706(Apr 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 10, 2158-2160(Oct 1972).

The possible appearance of post-discharge emission is verified for cleaned molybdenum surfaces, although the effect is not observed after adsorption of an oxygen monolayer. The presence of a monolayer is determined from the value of the normal cathode potential drop, which increases by a factor of 2 when the surface is covered by a monolayer. The current of emitted electrons is determined from the statistical delay of a discharge in a pure inert gas. The experiments carried out show that an oxygen monolayer does not give rise to post-discharge emission. The same result is obtained after heating the entire experimental apparatus to 225°C; processing with a very weak glow discharge with the electrode heated to 800 to 900°C leads to noticeable emission. The same amount of oxygen in the experimental apparatus with a barium surface increases the post-discharge emission current by an order of magnitude as compared with the value before oxygen adsorption. (auth)

Preparation and Fabrication

Refer also to abstract 4778.

3035 (RDT-M-2-2-T(10-73)) STAINLESS AND LOW-ALLOY STEEL FORGINGS (ASME SA-182 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D. C.). Oct 1973. 9p. RSO.

A standard prescribing requirements for stainless and alloy steel forgings (ASME SA-182 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 2-2T, dated May 1973. (JRD)

3036 (RDT-M-7-3-T(10-73)) STAINLESS STEEL BARS AND SHAPES (ASME SA-479 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D. C.). Oct 1973. 8p. RSO.

A standard prescribing requirements for stainless steel bars and shapes (ASME SA-749 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 7-3T, dated August 1972. (JRD)

3037 NARROW-GAP: A PROCESS FOR THE WELDING OF THICK METAL SHEETS. Helm, H. Ind.-Anz.; 95: No. 59, 1392-1394(1973). (In German).

The "Narrow-Gap" welding process has a number of special characteristics. The equipment and the experimental work of the process are described and the results are discussed. Possibilities for use of the process are pointed out. (GE)

3038 METAL FABRICATION TECHNIQUES USED IN THE DEVELOPMENT OF CANADIAN NUCLEAR FUELS. Nelles, J. S. (Chalk River Nuclear Labs., Ont.). Eng. J. (Montreal); 56: No. 5-6, 33-37(Jun 1973).

Aluminum cladding by extrusion is a process for applying protective coatings. It is semi-continuous so that components of any length can be clad without generating a butt for each press cycle. There is considerable choice in the external geometry of the cladding. Copper alloys canning is a technique for hot extruding materials where oxidation or lubrication problems are limiting. Graphite follow blocks allow complete extrusion of the billet material. Ball rolling is a method of cold reducing tube walls to desired dimensions. It is a versatile process for making small quantities of tubing. These fabrication techniques used in the development of Canadian nuclear fuels may have other commercial applications. (CA)

3039 HIGH-PERFORMANCE DEPOSITION WELDING FOR CLADDING REACTION VESSELS WITH CORROSION-PROOF HIGH-ALLOY MATERIALS. Chene, J.; Luginbuehl, P.; Beck, R. Sulzer Tech. Rev.; 55: No. 2, 73-78(Feb 1973).

Features of the submerged-arc strip cladding method are described. Faults in the form of coarsely rippled bead surfaces and poor bead interfaces are discussed. Difficulties in undercutting at bead interfaces of a reactor pressure vessel cladding led to a study of electromagnetic control of the arc. This method proved successful in the production of single-and multi-pass submerged-arc strip welds for nuclear power plants, and these welds were accepted by European and American acceptance authorities. Experience in cladding with strips 0.5 × 120 mm is described. The efficiency of submerged-arc strip cladding with arc control is compared with that of other cladding techniques. (9 figures, 4 tables, 13 references) (DLC)

3040 BRIEF DESCRIPTION OF CONSTITUTIVE EQUATIONS USEFUL IN TEMPERATURE- AND TIME-DEPENDENT STRESS AND FAILURE ANALYSIS. Quaass, S. T. pp 14-25 of Conference on Stress and Strain in Engineering. Sydney; Institution of Engineers (1973).

From conference on stress and strain in engineering; Brisbane, Australia (23 Aug 1973).

Reduced functions relating stress, strain, temperature, and time are described. Essentially, the basic functions are a stress-strain curve and a rupture stress/temperature–time relationship. When these are combined, and with conventional manipulation, any of the variables can be expressed in terms of the other. Characteristic constants for a variety of metals and alloys are given. The uses and applications of the functions are briefly described. (auth)

3041 POSTWELD AGING OF A METASTABLE BETA-TITANIUM ALLOY. Greenfield, M. A.; Pierce, C. M. (Air Force Materials Lab., Wright-Patterson Air Force Base, OH). Weld. J. (N.Y.); 52: No. 11, 524s-527s(Nov 1973).

From 54th AWS annual meeting; Chicago, IL (2 Apr 1973).

Bead-on-plate gas tungsten-arc (GTA) welds were made on the metastable beta alloy Ti–8Mo–8V–2Fe–3Al. The weldments were aged over a range of temperatures and times to produce yield strengths from 117 to 181 ksi. The observed spread in weldment elongation at a given strength level can be explained in terms of the microstructure and the fracture process. By unloading the test specimens prior to failure, crack nucleation sites and propagation paths were determined. Understanding of the fracture mechanism with suitable controls on the weldment microstructure have made it possible to overcome brittle failure and to use a welded beta sheet alloy at moderate strength levels. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 3013–3016, 4503, 4548–4550, 4711, 4715, 4725, 4726, 4731, 4741, 4754, 4759, and 4766.

3042 (ANCR-1125) STRAIN FATIGUE AND TENSILE BEHAVIOR OF INCONEL 718 FROM ROOM TEMPERATURE TO 650°C. Brinkman, C. R.; Korth, G. E. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Aug 1973. Contract AT(10-1)-1375. 17p. Dep. NTIS $4.00.

Results of tensile and fully reversed strain-controlled fatigue tests conducted on three heats of Inconel 718 that had been subjected to different solution annealing and aging treatments are presented. Tests were conducted at temperatures ranging from 22 to 650°C with fatigue tests defining behavior over the cyclic range of 10^2 to 10^6 cylces to failure. Average best-fit equations defining true stress-strain, strain-controlled fatigue, and cyclic stress-strain behavior are given for the two heat treatments characterized. Heat-to-heat variations in the elevated temperature tensile and fatigue behavior were found. Fatigue lifetime was seen to be dependent upon grain size, particularly at lower strain ranges. (auth)

3043 (BNWL-tr-98) THERMODYNAMIC PROPERTIES OF LIQUID K-Na ALLOYS. Kalinin, M. I. Translated from Zh. Prikl. Khim.; 46: No. 7, 1485-1488(1973). 9p. Dep. NTIS $3.00.

Results show that in K–Na solutions, a relatively small positive-negative departure from Raoult's law in potassium activity and only negative departures in sodium activity are detected. This alloy reaction is explained by the presence of structural groups of metallic composition Na_2K in the liquid alloy. The formation of alloys is accompanied by an exothermal heat effect. The molar entropy of the mixture attests to the ordering in K–Na alloys. Liquid potassium and sodium alloys are formed with volume decrease. (JRD)

3044 (CEA-R-4472) INFLUENCE OF HYDROGEN ON METALS BEHAVIOR. I. Mechanical Behavior of Ti–6% Al–6% V–2% Sn Alloy Versus Hydrogen: Influence of Heat Treatment and of Oxygen Content. Schaller, B. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Oct 1973. 106p. (In French). Dep. NTIS (U. S. Sales Only) $7.50.

Thesis.

Effects of H and O on the mechanical behavior of Ti–6% Al–6% V–2% Sn alloy during dynamic testing were investigated. The hydrogen susceptibility depends only slightly on its microstructure, acicular or equiaxed; it depends much more on conditions of hydrogen contamination and on the thermal history afterward. When the alloy has been stabilized by annealing in $\alpha-\beta$, and provided hydrogen absorption does not induce phase transformations, hydrogen sensitivity is relatively low; brittleness occurs suddenly but at a high concentration threshold (2000 ppM H), which coincides with hydrogen saturation of β phase. When the alloy includes unstabilized phases, its response to hydrogen changes whether it has been annealed or not; in the 300 to 500°C temperature range it is prone to ω-phase formation. In the absence of annealing, a reduction in ductility only occurs at high concentrations (>1500 ppM H). On the other hand, after annealing at 400°C, alloy hardening and a ductility decrease start even at the lowest hydrogen amounts and hydrogen susceptibility is very high. Low oxygen concentration (up to 2000 ppM) does not affect the good hydrogen tolerance of this alloy. Beyond 2500 ppM, oxygen, while improving tensile strength, severely decreases ductility. (auth)

3045 (CONF-731104-2) NEUTRON MEASUREMENT OF CRYSTAL FIELD SPLITTINGS IN TmAs AND TmBi. Davis, H. L.; Mook, H. A. (Oak Ridge National Lab., Tenn. (USA)). 1973. 5p. Dep. NTIS $3.00.

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973).

Analyses of inelastic neutron data collected for TmAs and TmBi were used to determine the Lea-Leask-Wolf parameters to be $x = -0.79$ (-0.81) and $W = -0.106$ (-0.0736) MeV. These results are discussed relative to a nearest-neighbor point-charge model, and to their usefulness in establishing a correlation between crystal-field quantities and ligand electronegativity. (auth)

3046 (COO-1198-1014) α-PEAK IN VANADIUM. Chang, H. Y.; Wert, C. A. (Illinois Univ., Urbana (USA)). 1973. 7p. (CONF-730844-1). Dep. NTIS $3.00.

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (17 Aug 1973).

It is believed that the α-peak is not a single, unique peak, probably varying with the presence of hydrogen, oxygen, and nitrogen. Two regions of deformation seem to exist for the α-peak obtained in the highest purity. Results show that the presence of immobile interstitials (oxygen and nitrogen) in solid solution suppresses the α-peak, apparently by locking the dislocations. Annealing of deformed specimens in the temperature range 200 to 300 C permits large-scale diffusion of interstitial oxygen or nitrogen to the dislocations. The precipitation peak is explained by the formation of incoherent hydrides causing the generation of many dislocations in the atmosphere of hydrogen in thermodynamic equilibrium with the hydride at the peak temperature. The damping peak originating from these dislocations should be the Snoek–Koester peak Type I. (21 references) (MCW)

3047 (INIS-mf-46) X-RAY LINE PROFILE ANALYSIS OF DEFORMED METALS AND ALLOYS. Kumar, L. (Bombay Univ. (India)). 1970. 128p. INIS.

Thesis.

A comparative study of the various methods of line profile analysis is made. Line profiles from cold-worked α-brass and nickel were analyzed by various known methods and the particle size and strain values obtained. Structural changes in the K-state alloy Ni–20 wt% Cr on cold working were studied. The x-ray line profile analysis of the disordered and K-state alloy at the various stages of deformation was carried out by Pines–Strenko method. It is observed that the particle size of the disordered material decreases continuously with increasing amount of deformation whereas the K-state alloy shows a nearly constant particle size value with increasing deformation. The strain values vary slowly with increasing deformation in both the disordered and K-state material. The stacking fault probability values of cold-worked bcc metals and alloys were determined by line profile analysis.

The alloys chosen for this study are Ta−20, 40, 60, and 80 at. % Nb; Ta−20, 40, 60, and 80 at. % Mo, in addition to pure Ta and Nb. X-ray diffraction profiles were recorded in both cold-worked and annealed conditions. The effective particle size values (D_e) were calculated using Pines−Sirenko method. The ratio D_e(110)/D_e (200) varies from 1.44 (for Ta) to 1.28 (for Nb) in the Ta−Nb system and from 1.49 (for Ta−20 at. % Mo) to 1.24 (for Ta−80 at. % Mo) in the Ta−Mo system. This clearly shows that stacking faults are present in these alloys. The values of D_e(100)/D_e(200) as well as the compound fault probability ($1.5\ \alpha + \beta$) show a maximum at about 60 at. % Ta for both the alloys systems. (INIS)

3048 (INP-835) MOESSBAUER SPECTROSCOPY OF ^{57}Fe IMPLANTED INTO METALS. Sawicka, B.; Sawicki, J.; Maydell-Ondrusz, E.; Lazarski, S. (Institute of Nuclear Physics, Krakow (Poland)). 1973. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

Implantations of 35-keV ^{57}Fe into Al, Mg, Ti, Zn, Zr, Cd, Pt, and Au foils were performed. Moessbauer absorption at room temperature was studied. (auth)

3049 (LA-UR-73-1398) PLUTONIUM METALLOGRAPHY. Cramer, E. M. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 16p. (CONF-730949-1). Dep. NTIS $3.00.

From international metallography society symposium on speciment preparation for metallography; Los Angeles, California, USA (23 Sep 1973).

An evaluation of the effectiveness of plutonium metallography reveals inadequacies in electrolysis preparation techniques. The probable causes and the approaches to the problems that have been proposed by the participating laboratories over the past two decades are reviewed. A brief history of the metal is included. (auth)

3050 (MLM-2027) EVALUATION OF HIGH-TEMPERATURE DYE PENETRANT. Blue, P. L. (Mound Lab., Miamisburg, Ohio (USA)). 28 Sep 1973. Contract AT-33-1-Gen-53. 8p. Dep. NTIS $3.00.

Conventional dye-penetrant systems, both fluorescent and visible-indicating, are limited by their chemical stability to an operating temperature no greater than 100°C. Recently, a penetrant system was developed by the Magnaflux Corporation extending the temperature range for penetrant inspection to 270°C. The new inspection system is basically identical to the old in that a penetrant, remover, and developer are employed. Aluminum crack blocks were used to demonstrate the relative performance of the high-temperature system compared with conventional penetrants. Also, the chemical activity of the penetrant system was investigated with regard to residual effects on a tantalum-based alloy, T-111. (auth)

3051 (ORNL-4922) EFFECT OF CARBON ON THE MECHANICAL PROPERTIES OF 2¼ Cr-1 Mo STEEL. Klueh, R. L. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 65p. Dep. NTIS $5.45.

Hardness, tensile properties, and creep-rupture properties of 2¼ Cr−1 Mo steel with 0.009, 0.030, 0.120, and 0.135% C were determined on the steels in various heat treated conditions. Metallographic studies showed the annealed (furnace-cooled) materials to be primarily proeutectoid ferrite with increasing amounts of spherical carbides and pearlite with increasing carbon content (the 0.135% C steel also contained some bainite). During normalization, (1 h 927°C, air cooled), bainite was formed regardless of carbon content; the 0.009% C and 0.030% C steels contained 1 to 2 and 15 to 20%, respectively, with the balance proeutectoid ferrite. The 0.120 and 0.135% C steels were entirely bainite. On tempering for 1 h at 704°C, carbides precipitated in both the proeutectoid ferrite and bainite. In each of the heat treated conditions, there was little difference in the room-temperature hardness of the 0.009 and 0.030% C steels; the two high-carbon steels also had similar hardnesses and were considerably harder than the 0.009 and 0.030% C steels. Tensile tests over the range 25 to 565°C at a nominal strain rate of 0.02/min indicated that strength depends on microstructure, which is determined by the carbon content. Above room temperature, the 0.009 and 0.030% C steels had similar yield strengths; at room temperature, grain size differences gave the 0.030% C steel the highest yield strength. However, because of the greater amounts of pearlite and bainite in the annealed and normalized-and-tempered steels, respectively, the 0.030% C steel always had the higher ultimate tensile strength. The two high-carbon steels (0.120 and 0.135% C) were both considerably stronger than the other two steels, and the 0.135% C steel had a strength advantage in both the annealed and normalized-and-tempered conditions. For the normalized-and-tempered steels at high temperatures, a decrease in strain rate to 0.00008/min led to a considerable decrease in the yield and tensile properties, with the magnitude of the effect increasing as the carbon content increased. The creep-rupture properties of the normalized-and-tempered steels show an effect of carbon that depends on temperature. At 565°C, the 0.120 and 0.135% C steels have similar strengths and are considerably stronger than the 0.009 and 0.030% C steels, which also have similar strengths. At 454 and 510°C, however, the properties for the 0.030% C steel are superior to those of the 0.009% C steel and approach those for the 0.120 and 0.135% C steels. These observations can be explained in terms of the type of carbide precipitation reactions that occur in 2¼ Cr−1 Mo steel. (auth)

3052 (ORNL-TM-4365) INTERIM REPORT ON WELDABILITY AND MECHANICAL PROPERTIES OF 16-8-2 STAINLESS STEEL FILLER METAL. Slaughter, G. M. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 27p. AT.

The weldability, mechanical properties, and microstructure of 16−8−2 welds were characterized and compared with standard type 316 welds. Gas tungsten-arc welds were emphasized since piping applications are of major concern. Wetting difficulties were encountered with bare type 16−8−2 filler metal, but sound welds could consistently be made by slightly modifying the manual welding technique. Automated machine welds were made with a weaving technique without wetting problems. A ferromagnetic phase believed to be martensite was discovered by magnetic etching techniques in the machine welds in varying amounts, predominantly in the later passes. X-ray diffraction patterns confirmed the presence of a higher concentration of body-centered cubic phase in the upper portion of the welds. Although no indication of tetragonality was detected in the body-centered cubic phases, the diffraction lines were broader than those of the austenitic phase. Tensile tests were performed at room temperature, 900, 1100, and 1200°F, and the data were fitted to a power-law equation. Derived allowable stress values were greater than those for type 316 base metal except for the ultimate stress value at 1200°F. Creep tests were performed at 900, 1100, and 1200°F, and the rupture stresses exceeded an approximate "95% lower confidence limit" for type 316 base metal based on an analysis by Blackburn. The studies are continuing, and the results will complement those reported. (auth)

3053 (RCN-193) STRESS-RUPTURE TESTS ON FAST-BREEDER FUEL CLADDING TUBES AT TEMPERATURES NEAR 1000°C. van Witzenburg, W.; Kwast, H. (Stichting Reactor Centrum Nederland, Petten (Netherlands)). Aug 1973. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

Experimental results of pressure tests on tubing of the austenitic steels Sandvik 12R72HV and Werkstoff nr. 1.4988 (DIN classification), with internal pressures up to 90 kg/cm^2 and at temperatures of 950, 1000, and 1050°C, are reported. The tubing geometry is representative for the canning of the prototype sodium-cooled fast reactor SNR-300. The rupture lives, which are temperature dependent, are shown to be longer for 12R72HV tubes than those of 1.4988 at internal pressures below 60 kg/cm^2. This pressure corresponds to a tangential stress in the tube wall of 4.5 kg/cm^2 for the geometry of tubes investigated. The strain at rupture of 12R72HV is considerably larger than that of 1.4988. The mode of failure of the tubes of both materials tested at a certain temperature is more likely to be violent, as opposed to fissures through the wall, at higher pressures. 12R72HV tubing is more susceptible to violent rupture than 1.4988 tubing. Metallographic examination shows that, in the temperature range considered, grain-boundary sliding plays a more important role in 1.4988 than in 12R72HV. Test data on tubing of Werkstoff nr. 1.4981 are presented as well. The creep strength of this material is inferior to 12R72HV and, to a lesser extent, to that of 1.4988. (12 figures, 15 references) (auth)

3054 CHARACTERISTICS OF AGING OF LOW-ALLOY MOLYBDENUM-BASE ALLOYS. Zueva, I. B.; Mezhennyi, Yu. O.; Skakov, Yu. A. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Chern. Met.; 14: No. 7, 119-121(1971). (In Russian).

Using x-ray diffractometry, a study on the redistribution of impurities in Mo alloys was carried out. The alloys contained the following impurities: 0.004 to 0.08% C, 0.12% Ti, 0.11 to 0.12% Zr, 0.001 O_2, 0.003 H_2, and 0.0003 to 0.0004% N. The alloys were annealed 1 h at 1000°C (starting state), and then annealed in a vacuum furnace at temperatures from 1000 to 1500°C for another h. Changes in the lattice period of solid-impurity solution were followed as a function of the annealing temperature at various sample depths. Alloy breakdown with precipitation of the carbide phases ZrC and Mo_2C occurs only in surface layers of the material, and hinders recrystallization. (tr-auth)

3055 EFFECTS OF ETCHING ON MAGNETIZATION REVERSAL IN $SmCo_5$ PARTICLES. McCurrie, R. A.; Carswell, G. P. (Univ. of Bradford, Eng.). Phil. Mag.; 28: No. 3, 611-621(Sep 1973).

A study was made of the effects of etching on the magnetic properties of $SmCo_5$ particles. It was shown that the coercivities can be substantially increased by etching in 1% HNO_3 for various times. By means of an intrinsic coercivity distribution analysis, it appeared that the reversal fields were not increased uniformly. Results suggested that the etching had a greater effect on particles which originally had relatively low intrinsic coercivities. An increase in the reversal fields was observed for all the specimens with particle diameters in the range 90 μm. The effect of various etching times was also investigated and it was shown that the coercivities H_C and H_R were approximately doubled after 1 min. No further change was observed for etching times up to 32 min. Several possible interpretations of the results were discussed. (auth)

3056 ELASTIC CONSTANTS OF PRASEODYMIUM SINGLE CRYSTALS IN THE TEMPERATURE RANGE 4.2-300 K. Greiner, J.D.; Schiltz, R.J. Jr.; Tonnies, J.J.; Spedding, F.H.; Smith, J.F. (Ames Laboratory, U.S. Atomic Energy Commission and Department of Metallurgy, Iowa State University, Ames, Iowa 50010). J. Appl. Phys. 44: No. 9, 3862-3867 (Sept 1973).

The elastic constants of single crystals of double hcp allotrope of praseodymium have been measured over the temperature range 4.2-300 K. Maxima are observed near 100 K in the temperature dependences of C_{11}, C_{33}, and $(C_{11} - C_{12})/2$, and minima are observed near 30 K. The maxima correlate with the upper temperature limit of an anomalous contribution which has been reported in the heat capacity. The minima correlate with peculiar behavior which has been observed in other physical phenomena. Inference may be drawn from the elasticity data that the thermal expansion behavior of praseodymium at low temperatures is very highly anisotropic. Comparison of the elastic constants of praseodymium with available data for the other rare earths shows that the praseodymium data fit a general pattern. Evaluation from the elastic constants shows that the Debye temperature of praseodymium remains nearly constant throughout the temperature range of measurement within ± 2 K of 152 K. (auth)

3057 DIPOLAR CONTRIBUTIONS TO MAGNETIC HYPERFINE FIELDS IN $Er_xY_{1-x}Fe_2$ AND $Tb_xY_{1-x}Fe_2$ COMPOUNDS. Dariel, M. P. (Israel Atomic Energy Commission, Beersheba); Atzmony, U.; Lebenbaum, D. Phys. Status Solidi (b); 59: No. 2, 615-620(1 Oct 1973).

Moessbauer effect measurements on ^{57}Fe have been carried out in the pseudobinary systems $Er_xY_{1-x}Fe_2$ and $Tb_xY_{1-x}Fe_2$ at 4.2, 80, and 300°K. The isotropic part of the hyperfine field acting on the iron nuclei includes a term due to polarization by the localized rare-earth spin. Magnetic dipolar contributions account only in part for the differences in the magnitude of the hyperfine fields at the inequivalent sites. (auth)

3058 HYPERFINE FIELDS IN FERROMAGNETICALLY ORDERED CUBIC LAVES-PHASE COMPOUNDS OF GADOLINIUM WITH NONMAGNETIC METALS. Dormann, E.; Buschow, K. H. J. (Technische Hochschule, Darmstadt, Ger.). Phys. Status Solidi (b); 59: No. 2, 411-418(1 Oct 1973).

By means of current zero-field spin-echo NMR technique the hyperfine fields at the Gd and X sites in the ferromagnetic cubic Laves phase compounds of the type GdX_2 (X = Al, Pt, Ir, Rh) are derived. The easy direction of magnetization in $GdIr_2$ is [100] in contrast to [111] in $GdAl_2$. (auth)

3059 EFFECT OF ZONE REFINING ON STRUCTURE OF IRREGULAR EUTECTICS. Kumar, L.; Merchant, H. D. (Indian Inst. of Tech., Kanpur). J. Cryst. Growth; 20: No. 2, 116-120 (Sep 1973).

Seven eutectic alloys (Pb-Sb, Bi-Cd, Zn-Zn_3Sb_2, Bi-$BiPb_3$, Bi-Sn, Bi-Zn, and Sn-Zn) made from 99.99% purity components were zone-refined in argon atmosphere to reduce further their impurity content. The zone-refined alloys were zone-leveled and directionally solidified. Several basic morphological changes were observed: coarsening (Pb-Sb), orientation of the minor phase along growth direction, some breakdown of regularity in the complex regular structure (Bi-$BiPb_3$, Bi-Sn), and horizontal alignment of the minor phase by rotation about the growth axis (Bi-Cd, Bi-Zn, Sn-Zn). Three classes of refined structures were obtained: irregular (Pb-Sb, Bi-$BiPb_3$, Bi-Sn), broken-lamellar (Bi-Cd, Br-Zn), and broken-rod (Zn-Zn_3Sb_2, Sn-Zn). (auth)

3060 USE OF LIQUID SODIUM AS A SOLVENT FOR CRYSTAL GROWTH. Evans, H. E.; Hayes, D. J. (Berkeley Nuclear Lab., Eng.). J. Cryst. Growth; 20: No. 2, 160(Sep 1973).

Liquid sodium, which has excellent heat transfer properties and dissolves both metals and nonmetals, is suggested as a solvent for crystal growth. (auth)

3061 INVESTIGATION OF ALLOYS OF THE SYSTEM Be-Fe-C BY THE NUCLEAR GAMMA RESONANCE METHOD. Alekseev, L. A.; Babikova, Yu. F.; Gladkov, V. P.; Zotov, V. S.; Kondar, V. I.; Skorov, D. M. At. Energ. (USSR); 35: No. 3, 173-176(Sep 1973). (In Russian).

Moessbauer measurements using ^{57}Fe were performed on alloys of beryllium and carbon (carbon content 0.06 to 0.39 wt.%). The Moessbauer spectra of Be-C alloys, annealed at 1130°C, contain a new doublet, having quadrupole splitting $Q \approx 0.28 \pm 0.07$ mm/s and chemical shift $\sigma = 0.43 \pm 0.04$ mm/s. (auth)

3062 ULTRASONIC ATTENUATION IN CRYSTALS UNDER HIGH PRESSURE. Hiki, Y.; Maruyama, T. (Tokyo Inst. of Tech.). (1973). vp.

From 5th international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

Ultrasonic attenuation of copper single crystals has been measured as a function of sound frequency (10 MHz to 150 MHz) by applying hydrostatic pressure to the specimens. The specimens were crystals with ⟨100⟩, ⟨110⟩, and ⟨111⟩ axial orientations, being 9 mm in diameter and 15 mm in length. The test specimens were inserted in a high-pressure vessel. The attenuation-frequency relation of each specimen was measured by changing the pressure from 1 to 4,000 atm. The specimens were then irradiated with ^{60}Co γ-rays to a dose of 10^7 R. The attenuation measurement was repeated. The difference of the attenuation before and after the irradiation was considered as due to the dislocation damping; the results were analyzed according to the theory of Granato and Luecke. (GE)

3063 EFFECTS OF STRAIN AMPLITUDE AND BIAS STRESS ON DISLOCATION INTERNAL FRICTION IN MOLYBDENUM SINGLE CRYSTALS. Mitchell, T. E.; Kenik, E. A.; Sklad, P. S.; Givala, R. (Case Western Reserve Univ., Cleveland). (1973). vp.

From fifth international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

The internal friction spectrum of Mo single crystals deformed systematically in tension at 450 and 156°K was investigated as a function of temperature, deformation strain, strain amplitude, and bias stress. (GE)

3064 SUPERCONDUCTIVITY OF SOME PALLADIUM ALLOYS HYDROGENIZED AT HIGH PRESSURE CONDITIONS. Skoskiewicz, T.; Szafranski, A. W.; Baranowski, B. (Inst. of Physical Chemistry, Warsaw). Phys. Status Solidi (b); 59: No. 2, K135-K136(1 Oct 1973).

Superconductivity of Pd-Ag-H, Pd-Rh-H, and Pd-Pt-H alloys hydrogenated at 20 kbar was studied. Data on electric conductivity versus temperature in the cryogenic range are presented. It is noted that the Pd-Pt-H and Pd-Rh-H alloys appear to offer the most promise as superconductors. (JRD)

3065 AMPLITUDE-DEPENDENT INTERNAL FRICTION IN RHENIUM. Callens-Raadscheiders, M.; de Batist, R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). (1973). vp.

From fifth international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

The internal friction of a polycrystalline rhenium specimen after different deformation and aging treatments was investigated both as a function of temperature and of strain amplitude. The mutual influence of these two parameters is interpreted in terms of a double-kink-generation relaxation process and of double-kink-stimulated mechanical breakaway, according to the Seeger-Pare-Alefeld and Granato-Luecke theories. (GE)

3066 MODIFICATION OF INTERNAL FRICTION PEAKS OF COLD-WORKED ALUMINUM AFTER FATIGUE TEST. Chevalier, J. L. (CEN, Grenoble, France); Pequin, P.; Fantozzi, G.; Esnouf, C.; Perez, J.; Gobin, P. F. (1973). vp.

From fifth international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

The effects of fatigue caused by torsion at 78°K on the internal friction spectrum of aluminum were studied. The defects created during the fatigue test lead to the formation of a striking peak P_3 and to a modification of the characteristics of the Bordoni relaxation. A comparison can be made between the effects of irradiation and fatigue. (GE)

3067 MICROPLASTICITY AND HIGH-AMPLITUDE DAMPING IN TANTALUM SINGLE CRYSTALS. Cowling, M. J.; Bacon, D. J. (Univ. of Liverpool). (1973). 9p.

From fifth international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

Relations between internal friction and conventional mechanical testing were examined by carrying out load–unload tests in the compression mode at strain sensitivities of approximately 10^{-6}. These microyield tests were performed at temperatures in the range 77 to 295°K on tantalum single crystals having a range of impurity concentrations and crystallographic orientations. Different dislocation distributions were studied by prestraining the specimens and two impurity concentrations are presented. (GE)

3068 GAS INTERSTITIALS IN BCC METALS. Savino, E. J.; Tewary, V. K. (Atomic Energy Research Establishment, Harwell, Eng.). (1973). vp.

From fifth international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

An "effective" gas-host atom interaction potential, obtained from the measured values of the dipole tensor, is used to calculate the static lattice distortion, activation energy, and migration volume of nitrogen and oxygen interstitials in niobium, tantalum, and vanadium, assuming both octahedral and tetrahedral occupancy. The Green function method for lattice statics was used throughout the work and the dynamic model is based on the Flynn and Stoneham theory of light interstitials migration. The results are compared with experimental measurements where available. (GE)

3069 X-RAY STUDY OF STACKING FAULTS IN A DOUBLE HEXAGONAL CLOSE-PACKED Au–Cd–In ALLOY. Babu Rao, Y.; Lele, S.; Rama Rao, P. (Banaras Hindu Univ., India). J. Appl. Phys.; 44: No. 7, 3028-3033(Jul 1973).

A study of the x-ray powder pattern resulting from a cold-worked hexagonal close-packed Au–Cd–In alloy containing 17.5 at.% Cd and 5.0 at.% In has been made. Quantitative analysis of observed anomalous peak broadening, peak shifts, and peak asymmetry in the powder pattern shows evidence for only three of the nine faults that have earlier been postulated for this structure, namely intrinsic–ch, intrinsic–h, and intrinsic–2h with respective fault probabilities of $\alpha_{ch} = 0.045$, $\alpha_h = 0.036$, and $\alpha_{2h} = 0.002$. (auth)

3070 INVESTIGATION OF THE EVAPORATION OF TANTALUM IN VACUO. Golubtsov, I. V. Heat Transfer–Sov. Res.; 5: No. 5, 18-22(1973).

A study is made of the evaporation of chemically pure tantalum from an open surface in vacuo and from an effusion chamber by integral variants of the Langmuir and Knudsen method in the temperature range up to 3100°K at various residual gas pressures. The measurement results are compared with the published data. (auth)

3071 NUMERICAL CALCULATION OF ISOMER SHIFT ON ^{151}Eu. Kobayasi, S. (Nihon Univ., Tokyo); Fukuchi, M.; Nagai, S. Solid State Commun.; 13: No. 7, 727-732(1 Oct 1973).

On the isomer shift of the Moessbauer effect on ^{151}Eu, Brix et al., (Phys. Lett.; 13: 140(1964)), Shirley et al. (Rev. Mod. Phys.; 36: 392(1964)), and Nowik and Ofer (Phys. Rev.; 132: 241(1963)) have recently measured large values: −1.5 and −0.8 cm/sec for Eu^{2+} compounds and bcc Eu metal relative to Eu^{3+} compounds, respectively. In order to clarify the origin of the phenomena, the energy band structure of bcc metallic Eu was calculated using Green's function method. The result was $u_{\Gamma_1}^{ncr}(0) = +2.83\ a_H^{-5}$, which leads to $2\ \Sigma_k^{occ}|\psi_k(0)|^2 = \xi \times 1.08 \times 10^{26}\ cm^{-3}$, $(\xi \sim 1)$, as the contribution of conduction electrons. This value is in good agreement with Brix's estimation: $+0.9 \times 10^{26}\ cm^{-3}$. Furthermore, the difference between the isomer shifts for Eu^{3+} and Eu^{2+} compounds is well understood by the present calculations of 5s wave functions in both crystals. (auth)

3072 INTERMETALLIC COMPOUND Ce_5Co_{19} AND THE INFLUENCE OF La ON ITS EXISTENCE. Khan, Y.; Feldman, D. (Ruhr Univ., Bochum, Ger.). J. Less-Common Metals; 33: 305-310(1973). (In German).

The compound $CeMMCo_5$ looks promising as a permanent magnetic alloy. Reliable production of such materials requires knowledge about the constitution of the multicomponent system in the neighborhood of the composition $Ce_{0.55}La_{0.25}Nd_{0.15}Pr_{0.05}Co_5$. As a first step toward this 0.05 goal, alloys in the ternary system La–Ce–Co are studied in the neighborhood of the composition $Ce_{0.6}La_{0.4}Co_{3.0}{}^{+1.1}_{-1.1}$. It is important to note that a difference exists between the binary boundary systems Ce–Co and La–Co. In contrast to the La–Co system, the Ce–Co system displays a compound $CeCo_{3.8}$ which occurs between the compounds Ce_2Co_7 and $CeCo_5$. The structure of the new phase as well as its range of existence under La substitution is described. (tr-auth)

3073 USE OF CENTRAL PAIR POTENTIALS IN THE LATTICE DYNAMICS OF YTTRIUM. Verma, M. P.; Upadhyaya, J. C. (Agra Coll., India). Solid State Commun.; 13: No. 7, 779-783 (1 Oct 1973).

A phenomenological model for the study of lattice dynamics of hcp metals was developed on the basis of a 5-neighbor central-pair potential between ions and an approximate electron–ion interaction. The dispersion curves of yttrium derived from this model present a good agreement with the experimental curves and the deviations which are most pronounced near the zone boundary in $(01\bar{1}0)$ direction are nowhere larger than 6%. (auth)

3074 MAGNON DISPERSION IN $TbAl_2$. Buehrer, W. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland); Godet, M.; Purwins, H. G.; Walker, E. Solid State Commun.; 13: No. 7, 881-884(1 Oct 1973).

Slow neutron inelastic scattering was used to determine the magnon dispersion relation in $TbAl_2$ at 4.6°K. Energies of magnons in symmetry points are in MeV: Γ 1.7 ± 0.1 and 6.0 ± 0.1, X 5.1 ± 0.2 (degenerate); L 3.0 ± 0.1 and 7.4 ± 0.1 for the acoustic and optical modes respectively. An analysis of the experimental curves in terms of interatomic exchange parameters shows long-range order and oscillations in real space. (auth)

3075 INFLUENCE OF A DISPERSION ON THE DUCTILITY AND FRACTURE BEHAVIOR OF IRON. Place, T. A.; Lund, J. A. (Univ. of British Columbia, Vancouver). J. Test. Eval.; 1: No. 4, 349-352(Jul 1973).

Iron and iron–thoria strips were produced by a technique involving coprecipitation, hydrogen reduction, compaction, and hot rolling. Flat specimens of iron and two thoria-dispersion strengthened alloys were pulled in tension at temperatures in the range 77 to 373°K. The low-temperature ductility of the hot-rolled powder compacts was improved by the dispersion, and the ductile-brittle transition temperature was reduced. The onset of mechanical twinning, discontinuous yielding, and Luders band failures was suppressed to lower temperatures in the dispersion hardened material. The necking and fracture behavior was strongly influenced by the dispersion. Stringers of thoria particles acted as crack initiation sites, particularly if they lay transverse to the loading direction. (auth)

3076 HIGH-TEMPERATURE DIFFUSION MEASUREMENTS IN TUNGSTEN METAL BY MEANS OF AUTORADIOGRAPHY. Kozma, L.; Bartha, L. (Research Inst. for Technical Physics, Budapest). Isotopenpraxis; 9: No. 6, 203-205(Jun 1973).

The diffusion of ^{59}Fe and ^{185}W in powder-metallurgical swaged tungsten samples was investigated by autoradiographic method in the temperature range of 1300 to 1900°C. The results proved that in the case of ^{185}W only surface diffusion and in the case of ^{59}Fe both, surface and grain-boundary diffusion exist. (auth)

3077 FERMI SURFACE. Its Concept, Determination, and Use in the Physics of Metals. Cracknell, A. B.; Wong, K. C. Oxford; Clarendon Press (1973). 565p.

The book describes the main theoretical and experimental methods for determining the shape of the Fermi surface of a metal. The actual shapes for all the metallic elements are described and gaps in the present knowledge are indicated. It is shown how these known Fermi surfaces can be used to give quantitative explanations of many of the electronic properties of metals, and effects of electron interactions on the Fermi surface are discussed. The subject is covered in chapters entitled: band structure, the Fermi surface, and the free-electron model; the calculation of electronic energy band structures and Fermi surfaces; experimental methods for investigating band structures and Fermi surfaces; the Fermi surfaces of the metallic elements; electron interactions; alloys and metallic compounds. A bibliography is included. (UK)

3078 ORIENTATION RELATIONSHIP BETWEEN THE α AND ω PHASES OF TITANIUM AND ZIRCONIUM. Usikov, M. P.; Zilbershtein, V. A. (Inst. of Physical Metallurgy and Metal Physics, Moscow). Phys. Status Solidi (a); 19: No. 1, 53-58(16 Sep 1973).

High-pressure treated titanium and zirconium were investigated by means of transmission-electron microscopy. The specimens consisted mainly of retained ω phase, while in some regions α phase platelets were observed. Two crystallographically nonequivalent sets of matrices of correspondence between the α and ω phase were calculated using known matrices for the α and β phases and for the β and ω phases. It is shown that one of the two sets of matrices is valid for description of mutually parallel directions in the atomic and reciprocal lattices. The orientation relationship as defined by this set of matrices may be given in the form $(001)_\alpha \parallel (011)_\omega$, $[100]_\alpha \parallel [\bar{2}\bar{1}1]_\omega$. A possible mechanism of the $\alpha \rightleftharpoons \omega$ transformation is proposed. (auth)

3079 HYPERFINE INTERACTIONS OF TRANS-LEAD ELEMENTS STUDIED BY NUCLEAR RADIATIONS. Ansaldo, E. J. (Univ. of Aarhus, Denmark). Phys. Status Solidi (a); 19: No. 1, 11-51(16 Sep 1973).

The applications of nuclear radiation methods to the study of hyperfine interactions (hfi) for elements beyond Pb in the periodic table are reviewed. A general discussion of hfi is presented along with a review of specific methods. The techniques are illustrated whenever possible by their application to the actinides, with emphasis on the unsolved aspects of the results. A special method of sample preparation is ion implantation, in which stable or radioactive ions of practically any element are shot into the host, either by means of isotope separators or the recoil energy of nuclear reactions or radioactive decays. The location of the implanted (recoiled) atom in the lattice has to be assessed for a reliable determination of the hfi. Therefore, a chapter on the channeling technique is also included. (JRD)

3080 STATISTICAL TREATMENT OF PINNING ON POINT DEFECTS INCLUDING SOME CORRELATION EFFECTS. Takacs, S.; Ullmaier, H. (Electrotechnical Inst., Bratislava). Phys. Status Solidi (a); 19: No. 1, K35-K38(16 Sep 1973).

The dependence of the pinning force in Nb on the defect concentration and magnetic field was qualitatively established. The correlations of defect concentrations in neighboring volumes of the same order of magnitude are examined. An enhanced volume pinning force at low defect densities was found. An explanation of the enhanced volume pinning force at low defect densities is the occurrence of an attractive interaction in pure Type-II superconductors with small Ginzburg-Landau parameters (Type-II/I superconductors). For these materials and for low flux densities it can be shown that the elastic constants c_{ij} that appear in an expression for the volume pinning force F_P are strongly reduced, i.e., the flux line lattice is "softer" compared with the case of repelling lines. The attractive interaction decreases with decreasing electron mean free path (i.e. increasing x) and finally changes to a repulsive one. Therefore, an enhancement of F_P is expected due to the reduced c_{ij} only at low fields and low defect densities which is in qualitative agreement with the experimental observations. (JRD)

3081 STRUCTURE OF VANADIUM AND CHROMIUM THIN FILMS. Gladkikh, N. T.; Zhukova, N. A.; Protsenko, I. E.; Chekarev, M. A. (Kharkov State Univ.). Fiz. Metal. Metalloved.; 36: No. 1, 84-90(1973). (In Russian).

The phase composition of vanadium and chromium films was investigated as a function of the thickness and temperature of the backing, the rate of condensation, and the residual gas pressure (~10^{-5} and 10^{-6} torr). It is shown that phases near the compositions VO and CrO are formed in the films at a vacuum of 10^{-5} torr. A study was made of the structural transformations on aging or annealing these phases and of the conditions for formation of the chromium phase in the films that has a structure of the type of β-W. The bcc lattice parameter was obtained as a function of thickness for films of vanadium and chromium condensed in a vacuum of ~10^{-5} and ~10^{-6} torr. (tr-auth)

3082 INFLUENCE OF INTERCRYSTAL MISORIENTATION ANGLE ON BRITTLENESS OF TUNGSTEN BICRYSTALS. Yastrevkov, A. A.; Ivakin, Yu. P. Fiz. Metal. Metalloved.; 36: No. 1, 135-139(1973). (In Russian).

It is known that grain boundaries have a great effect on the low-temperature brittleness of tungsten which in the single-crystal state possesses significant reserves of plasticity. It is believed that brittleness ensues with the appearance of high-angle grain boundaries in tungsten. The effects of intercrystallite boundaries with a different misorientation on the brittleness of tungsten were investigated. Bending tests were run on bicrystal platelets 1 mm thick, 6 to 8 mm wide and 35 mm long. The distance between support points was 16 mm. The load was applied at a rate of 20 mm/min at the site of the intercrystallite boundary. The bending deflection was measured before breaking of the sample. The surface of the break was investigated under an optical microscope. With a boundary misorientation of less than 6° the bicrystal samples show a high plasticity characteristic of single-crystal tungsten. With a boundary misorientation exceeding 6°, all the bicrystal samples turned out to be brittle. The greatest fall in plasticity occurs at a 6 to 8° misorientation angle. The brittleness of bicrystals at misorientations greater than 6° is caused by a decrease in strength of the intercrystallite boundary. No microcracks could be found at boundaries with a misorientation less than 6°. (tr-auth)

3083 INVESTIGATION OF RESISTANCE TO SMALL PLASTIC DEFORMATIONS OF LOW-ALLOYED NIOBIUM ALLOYS. Prokoshkin, D. A.; Vasil'eva, E. V.; Markova, S. A. (Moscow Higher Technical School). Fiz. Metal. Metalloved.; 36: No. 1, 149-153 (1973). (In Russian).

A study is made of the effect of small amounts (1 at. %) of additives (Ti, Zr, V, Ta, Mo, or W) on the microhardness, yield point $\sigma_{0.002}$, and modulus of elasticity of niobium metal. It is noted that alloying with these elements causes an increase in the yield point of niobium. A significant increase in yield point (by 80 to 130%) can be attained by annealing niobium and its alloys in vacuum below the recrystallization temperature, i.e., about 900°C for niobium and 1000°C for its alloys. (tr-auth)

3084 PECULIARITIES OF MAGNETIC HYSTERESIS IN SINGLE CRYSTALS OF RCo_5 COMPOUNDS. Ermolenko, A. S.; Korolev, A. V. (Inst. of Metal Physics, Moscow). Fiz. Metal. Metalloved.; 36: No. 1, 52-59(1973). (In Russian).

On single-crystal samples of the compounds $SmCo_5$ and $GdCo_5$ a jump change in magnetization is observed that is connected with the occurrence of a domain structure hysteresis. The jump character for the change in magnetization can be related to the hysteresis of formation and growth of magnetized nuclei, that is, to the occurrence of a multidomain state hysteresis. It is shown that the magnetization itself and the magnitude of the magnetic field at which magnetization occurs depend substantially on the surface state of the sample. The effect of various factors on the magnetizing field is investigated. (tr-auth)

3085 WEAKENING OF METALS DURING SUPERCONDUCTING TRANSITION. Pashitskii, E. A.; Gabovich, A. M. (Inst. of Physics, Kiev). Fiz. Metal. Metalloved.; 36: No. 1, 186-187 (1973). (In Russian).

It is shown that the decrease in activation energy during transition of a metal to the superconducting state is related to an increase in free energy of the superfluid component of the conduction electrons shielding the perturbation of the positive ion charge in the region of the crystal lattice deformation near dislocations. For simplicity, a straight edge dislocation in the metal is considered. Lattice distortion in the vicinity of the dislocation line is accompanied by a local change in the average ion density, and this condition leads to a perturbation in electron density. The increase in free energy arises from a deviation of the lattice parameter in the region of an inhomogeneous deformation in a superconductor. The potential energy of the dislocations in the metal includes both the energy of the elastic lattice deformation and also the electrostatic energy of the electrons screening the perturbation of the positive ion charge. Therefore an increase in free energy of the superconducting electron gas near the dislocations leads to an increase in potential energy of the latter, which is equivalent to a decrease in barriers against dislocation movement. An explanation is given for the strength loss of lead in going from the normal to the superconducting state. (SJR)

3086 CALIBRATION OF HYSTERESIS LOSSES IN HARD SUPERCONDUCTORS. Drozhenko, V. G.; Dudin, V. I.; Mikhailov, N. N. Fiz. Metal. Metalloved.; 36: No. 1, 191-192(1973). (In Russian).

In creating efficient superconducting materials for operation in slowly varying magnetic fields (~1 Hz) it is necessary to take into account hysteresis losses associated with the irreversibility of the magnetization process. The hysteresis losses are a function of the external field. A constant coefficient can be calculated by determining the magnetization as a function of external field for a superconductor of the first kind (lead). This method of calibration was then used to determine hysteresis losses occurring in wire samples made of NT-60 alloy. (SJR)

3087 PINNING OF DISLOCATIONS WITH INTERSTITIAL OXYGEN ATOMS AND TEMPERATURE DEPENDENCE OF YIELD LIMIT OF NIOBIUM. Blanter, M. S.; Ivanov, I. I.; Kostomarov, S. M. Fiz. Metal. Metalloved.; 36: No. 1, 213-215(1973). (In Russian).

Polycrystalline niobium melted by an electron beam had a composition of 0.027 wt % O, 0.008 N, 0.001 H, 0.16 Ta, <0.005 Fe, <0.01 Si, and <0.005 wt % W. Wire samples were placed in a cold, upper zone of a vertical vacuum furnace having a pressure of ~5×10^{-6} mm Hg, held in the hot zone 5 min, and were quenched in a bath containing vacuum oil or a liquid alloy of gallium with 25% In having a melting point of 16°C. Elongation tests were run at a deformation rate of 0.16 min^{-1}. Above a quenching temperature of 475°C the yield point drops to a minimum value. The presence of a sharp yield point is an indication of dislocation pinning, where in solid solutions the pinning is effected by an atmosphere of impurity atoms at the dislocations. The absence of a sharp yield point after quenching at temperatures above 475°C may indicate that in this case the dislocations are free of an atmosphere of interstitial atoms. Cooling in liquid metal fixes this state. The behavior of niobium containing a higher percent of oxygen impurity (0.057 wt %) was also investigated. In this case the temperature where the sharp yield point vanishes was increased from 475 to 650°C. This observation agrees with the view that the disappearance of the sharp yield point during quenching occurs as a result of the freeing of the dislocations from the atmosphere of interstitial atoms. It is concluded that dislocation pinning in niobium by an atmosphere of impurity oxygen atoms noticeably increases the yield point, but is not the reason for its strong temperature dependence. (SJR)

3088 THERMAL emf IN ALLOYS OF NICKEL WITH HAFNIUM, TUNGSTEN, AND RHENIUM IN RANGE 77 TO 1300°K. Alizade, Z. I.; Beilin, V. M.; Zeinalov, T. I.; Rozel'berg, I. L. Fiz. Metal. Metalloved.; 36: No. 1, 192-195(1973). (In Russian).

Thermo-emf's were measured in Ni–Hf, Ni–W and Ni–Re alloys at 273 to 1273°K with respect to platinum, and at 77 to 273°K with respect to copper. The thermo-emf value in Ni–W and Ni–Re alloys is primarily positive with the exception of the Ni + 1.08 at. % Re where at temperatures above 400°K, $S < O$. In alloys containing hafnium S is everywhere negative, and in absolute value is smaller than in pure nickel. The thermo-emf's of the alloys depend on temperature in a nonmonotonic manner. At comparatively low temperatures, all alloys show anomalies in the form of maxima, minima, and inflection points. These details are related to a ferromagnetic transformation in the alloys. The curie temperature is given as a function of alloy composition from the thermo-emf data. (SJR)

3089 INTERDIFFUSION IN THE SYSTEM MOLYBDENUM–OSMIUM. Erley, W.; Wagner, H. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi (a); 19: No. 1, K23-K26 (16 Sep 1973).

The volume interdiffusion in polycrystalline Mo–Os diffusion couples was investigated. Results are tabulated for diffusion time at 1874 to 2177°C. Data are presented graphically for Mo concentration in the couple as a function of distance and on the interdiffusion coefficient logarithm as a function of Mo concentration at various temperatures. (JRD)

3090 VARIATIONS OF ENERGY AND INTENSITY OF EXO-ELECTRONS FROM BeO. Kortov, V. S. (Uraler Polytechnisches Institut, Sverdlovsk, USSR). Phys. Status Solidi (a); 19: No. 1, 59-66(16 Sep 1973). (In Russian).

Exoelectron energy and intensity in BeO after electronic bombardment and x-irradiation were simultaneously measured in a vacuum of 5×10^{-7} torr. Emission constants and electron trap parameters were calculated. The exoemission mechanism of BeO is discussed considering electron energy measurements. (auth)

3091 SPECIFIC HEAT OF IRON-RICH Fe–Cr, Fe–Al, AND Fe–V ALLOYS BETWEEN 600 AND 1200°K. Orehotsky, J.; Schroeder, K. (Wilkes Coll., Wilkes Barre, PA). Phys. Status Solidi (a); 19: No. 1, 93-102(16 Sep 1973).

The specific heats of iron alloys with up to 21 at. % aluminum, 30 at. % chromium, and 30 at. % vanadium show sharp λ-peaks even for alloys with high nonferromagnetic impurity concentration. Only the alloy with 40 at. % chromium has a rounded peak. The temperature dependence of the magnetic specific heat c_M follows frequently a function of the form $c_M \propto \ln \epsilon$ over a range $10^{-1} > \epsilon > 10^{-3}$ above the Curie temperature T_C. ϵ is defined as $\epsilon = |T/T_C - 1|$. A logarithmic dependence on ϵ for c_M is found below T_C only in intervals of the order of $10^{-1} > \epsilon > 10^{-2}$ for some alloys. Magnetic energy and entropy values are compared with theoretical predictions from series expansion calculations. It is frequently not possible to associate magnetic specific heats uniquely with either the Heisenberg model or the Ising model. (auth)

3092 CONFIRMATION OF EXISTENCE OF fcc ERBIUM BY MEASUREMENT OF THE WEIGHT INCREASE WHICH ACCOMPANIES FORMATION OF Er_2O_3. Curzon, A. E.; Chlebek, H. G. (Simon Fraser Univ., Burnaby, B. C.). J. Phys., F (London); 3: No. 10, L176-178(Oct 1973).

A face-centred-cubic phase occurs when thin films are vacuum condensed from erbium vapour. The weight increase that occurs when this phase is oxidized to Er_2O_3 shows that the phase is a new form of metallic erbium and is not Er O as has been suggested by other workers. (auth)

3093 ELECTRIC FIELD GRADIENT AT Ta IN GROUP-IVB METALS. I. α-Zirconium. Kaufmann, E. N. (Bell Telephone Labs., Murray Hill, NJ). Phys. Rev., B; 8: No. 4, 1382-1387(15 Aug 1973).

For Ta in hcp α-zirconium at room temperature, an interaction frequency ν_Q(482-keV state in ^{181}Ta) = 312 ± 3 MHz was found using the time-differential perturbed-angular-correlation technique. This corresponds to an electric field gradient at Ta in α-Zr of $|eq| = (5.1 \pm 0.2) \times 10^{17}$ V/cm^2. Results indicate a substantial electronic contribution to the magnitude and temperature dependence of the field gradient. (30 references) (auth)

3094 ELECTRIC FIELD GRADIENT AT Ta IN GROUP-IVB METALS. II. α-Titanium. Kaufmann, E. N. (Bell Telephone Lab., Murray Hill, NJ). Phys. Rev., B; 8: No. 4, 1387-1390(15 Aug 1973).

For Ta in hcp α-titanium at room temperature, an interaction frequency ν_Q (482-keV state in ^{181}Ta) = 333 ± 2 MHz was found using the time-differential perturbed-angular-correlation technique. This corresponds to an electric field gradient at Ta in α-Ti of $|eq| = (5.45 \pm 0.22) \times 10^{17}$ V/cm^2. Results indicate a somewhat smaller electronic contribution to the field gradient than has been found for a Zr host. (auth)

3095 ELECTRIC FIELD GRADIENT AT Ta IN GROUP-IVB METALS. III. ω-Zirconium. Kaufmann, E. N.; McWhan, D. B. (Bell Telephone Lab., Murray Hill, NJ). Phys. Rev., B; 8: No. 4, 1390-1397(15 Aug 1973).

The time-differential perturbed-angular-correlation technique was used to observe the nuclear-electric-quadrupole interaction at ^{181}Ta(482 keV) as an impurity in the ω-phase modification of Zr metal. The measured interaction frequencies for the two crystallographically inequivalent sites are ν_Q^A = 280 ± 2 MHz, which correspond to electric field gradients of $|eq^A| = (4.58 \pm 0.19) \times 10^{17}$ V/cm^2 and $|eq^B| = (6.24 \pm 0.25) \times 10^{17}$ V/cm^2, respectively. The ratio of field gradients is in remarkably good agreement with results of a point-ion lattice-sum calculation and the gradient magnitudes support a reduced-valence picture of the ω structure. (auth)

Radiation Effects

3096 (CONF-731028-1) ION RADIATION DAMAGE. Oen, O. S.; Narayan, J.; Noggle, T. S. (Oak Ridge National Lab., Tenn. (USA)). 1973. 16p. Dep. NTIS $3.00.

From international conference applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973).

The depth distribution of damage energy deposited in solids by energetic ions was calculated and results are compared with the experimental damage found in copper irradiated with 10^{16} 1-MeV protons at ambient temperature. The general form of the experimental damage profile from the transmission-electron-microscope measurements agrees well with that calculated. (6 figures, 22 references) (auth)

3097 (FZK-394-1) NERVA IRRADIATION PROGRAM. GTR 23, Volume I. Combined Effects of Reactor Radiation and Cryogenic Temperature on NERVA Structural Materials. McDaniel, R. H.; Bradford, E. W.; Lewis, J. H.; Wattier, J. B. (General Dynamics Corp., Fort Worth, Tex. (USA). Convair Aerospace Div.). Jan 1973. Contract SNPC-73. 165p. Dep. NTIS $10.25.

Specimens fabricated from structural materials that were candidates for certain NERVA applications were irradiated in liquid nitrogen (LN_2), liquid hydrogen (LH_2), water, and air. The specimens irradiated in LN_2 were stored in LN_2 and finally tested in LN_2, or at some higher temperature in a few instances. The specimens irradiated in LH_2 underwent an unplanned warmup while in storage so this portion of the test was lost; some specimens were tested in LN_2 but none were tested in LH_2. The test specimens and test specifications were provided by Aerojet Nuclear Systems Company and Westinghouse Astronuclear Laboratory. However, with the termination of these companies' participation in the program, the Los Alamos Scientific Laboratories has been designated as the recipient of the raw data and untested specimens. The Ground Test Reactor was the radiation source. The test specimens consisted mainly of tensile and fracture toughness specimens of several different materials, but other types of specimens such as tear, flexure, springs, and lubricant were also irradiated. Materials tested include Hastelloy X, Al, Ni steel, steel, Be, ZrC, Ti–6Al–4V, CuB, and Ti–5Al–2.5Sn. (JRD)

3098 (IS-3182) RADIATION HARDENING AND RADIATION ANNEAL HARDENING IN VANADIUM–OXYGEN ALLOYS. Wechsler, M. S.; Alexander, D. G.; Bajaj, R.; Carlson, O. N. (Iowa State Univ. of Science and Technology, Ames (USA)). 1973. 20p. (CONF-730813-10). Dep. NTIS $3.00.

From conference on defects and defect clusters in bcc metals and their alloys; Gaithersburg, Maryland, USA (14 Aug 1973).

Tensile tests were performed on high-purity vanadium containing 60 to 3160 weight ppM oxygen. Portions were irradiated to 1.2×10^{19} neutrons/cm^2 (E > 1 MeV) at 105°C and to 1.5×10^{19} neutrons/cm^2 at 85°C. The following were studied: (1) a study of radiation-anneal hardening (RAH) in which the additional hardening upon post-irradiation annealing between 100 and 800°C was observed, as well as the recovery to pre-irradiation properties, and (2) the effect of irradiation on the temperature dependence of yielding in unirradiated, as-irradiated, and radiation-annealed specimens. The RAH (yield stress increase) occurs over the annealing temperature range of 100 to 400°C, and appears to increase in magnitude with increasing oxygen concentration. Recovery to pre-irradiation yield stress values takes place at 500 to 700°C. The mechanism proposed is that interstitial oxygen migrates to radiation-produced defect clusters, thus strengthening them as barriers to slip dislocation motion. The temperature dependence of the yield stress was observed over the range of test temperatures from 4 to 400°K. Radiation hardening increased with increasing oxygen concentrations for tests at 195 to 400°K. This was interpreted tentatively in terms of the formation of stronger dispersed barriers for higher oxygen alloys due to some trapping of oxygen at defect clusters during irradiation. At 4 and 77°K, where twinning occurs, the radiation hardening diminished with increasing oxygen concentration. Radiation softening did not occur, when analyzed in terms of the total yield stress. (10 figures, 44 references) (auth)

3099 STEREO ELECTRON MICROSCOPY OF SELF-ION RADIATION DAMAGE IN ALUMINIUM SINGLE CRYSTALS. Johnson, E.; Ytterhus, J. A. (Univ., Copenhagen). Phil. Mag.; 28: No. 3, 489-503(Sep 1973).

Aluminium single crystals were irradiated at room temperature with 50-keV Al^+ ions along low-index crystallographic directions. Depth distributions of the produced defects were obtained by stereo electron microscopy. They were compared with the theoretical damage distribution for an amorphous target, and good agreement was found for random irradiations. For crystals irradiated along channelling directions, the distributions were shifted towards larger depths, and the damage density was reduced by an order of magnitude. For high doses ($\sim 6 \times 10^{14}$ ions cm^{-2} in random orientation), the loops were seen to coalesce and to align along rows. This effect, probably due to the elastic loop interaction, was proposed as a stage in the damage development, preceding the formation of dislocation tangles. (auth)

3100 SWELLING OF BERYLLIUM DURING POST-IRRADIATION ANNEALING: THE ROLE OF GRAIN BOUNDARIES. Sernyaev, G. A.; Gol'tsev, V. P.; Chechetkina, Z. I. At. Energ. (USSR); 35: No. 3, 175-176(Sep 1973). (In Russian).

Samples of hot-pressed beryllium (size of initial particles 600 μ), irradiated at 60°C with an integrated flux of fast (E ≥ 0.85 MeV) neutrons of 5.1×10^{21} cm^{-2}, were subjected to long-term isothermal annealing and their densities and structural states were periodically recorded. It was found that in the overall course of swelling two stages can be distinguished: intensive swelling (stage I) and moderate swelling (stage II). During both stages, the dependence of swelling on annealing time can be described by an expression of the form: $\Delta V/V_0 = A\tau^B$. In stage I, B = ~1 and in stage II, B = 0.25. The porosity structures of annealed samples are characterized by significant differences in size of intra-grain and grain boundary pores (the latter being larger) and in the absence of pores in the neighborhood of boundaries. A general growth of pores (especially along grain boundaries) and a broadening of pore-free zones are observed to occur as temperature and annealing time increase. Observation of the kinetics of this broadening shows that it occurs only during stage I, where $l_{av} \sim \tau^{0.8}$ (l_{av} is the average width of the pore-free zone in the neighborhood of the boundary and τ is the annealing time). The results are discussed from the point of view of pore migration and coalescence. The difference in behavior of boundary and intra-grain pores is thought to be associated with the difference in the activation energy of such migration. (auth)

3101 SWELLING OF BERYLLIUM SUBJECTED TO HIGH TEMPERATURES AND IRRADIATION DOSES. Gol'tsev, V. P.; Chechetkina, Z. I.; Sernyaev, G. A.; Ol'khovikov, V. A. 35: No. 3, 178-180(Sep 1973). (In Russian).

Experimental data are presented that characterize the behavior of various grades of beryllium subjected to high integrated neutron fluxes and high irradiation temperatures. Post-irradiation densities and structures of samples were determined. In analyzing the results, it can be concluded that, during high-temperature irradiation, the density of beryllium decreases, the decrease in density being proportional to the integrated neutron flux and the irradiation temperature. Moreover, the change in density depends significantly on the kind of material. For mono- and bicrystal beryllium it is less than for cermet beryllium; the swelling of the latter, in turn, increases with size of initial particles. Results of structural studies indicate that the change in cermet beryllium density is to a great extent determined by the rate of coalescence of pores in boundary regions, and that coalescence increases with size of grains. The results present a picture of density change dose dependence in hot-pressed beryllium for the temperature range of practical interest (600 to 700°C). (auth)

3102 MOESSBAUER STUDIES OF THERMAL-NEUTRON RADIATION DAMAGE IN AN ORDERED ALLOY. Simopoulos, A.; Vogl, G. (Technische Univ., Munich). Phys. Status Solidi (b); 59: No. 2, 505-516(1 Oct 1973).

Mössbauer effect measurements on ^{197}Au were done to study neutron radiation damage in the ordered alloy CoPt. Platinum-196 nuclei were irradiated by neutrons to produce unstable ^{197}Pt nuclei which β decay to the ^{197}Au Mössbauer nuclei. The average recoil energy of ≈30 eV associated with thermal-neutron capture led to replacement collisions of ^{197}Pt ions with their neighbors. The Mössbauer results show that, by irradiation at 330°K, about 40% of the produced ^{197}Au atoms have left their ordered sites with eight Co and four Pt nearest neighbors and ended up in sites with an average of (5.5 ± 0.3) Co and (6.5 ± 0.3) Pt nearest neighbors. This result can be explained by a model of replacement collisions of the recoil atoms with nearest or next nearest neighbors in the ⟨110⟩ or ⟨100⟩ directions. The results agree fairly well with computer-simulation predictions for low-energy recoil in fcc metals. (auth)

3103 SELF-INTERSTITIAL RELAXATION IN HEAVILY IRRADIATED BCC, HCP, AND FCC METALS. Moser, P.; Verdone, J.; Chambron, W.; Hivert, V.; Pichon, R. (CEN, Grenoble, France). (1973). vp.

From fifth international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

Several internal friction peaks are found in molybdenum and nickel irradiated at 28°K and in zirconium and titanium irradiated at 77°K. Some of them correspond to the free interstitial reorientation and migration. This interstitial disappears by correlated and uncorrelated annihilation after tridimensional migration at the end of stage I. Double peaks are found which can be interpreted in terms of "frozen free split" phenomena, as predicted by Nowick. The split-interstitial of nickel does not give rise to any peak, while studies on nickel, doped with 0.1% Mn and electron irradiated at 20°K show that the presence of an impurity in the neighborhood of the self-interstitial can increase the anisotropy of the strain ellipsoid and give rise to internal friction peaks. (GE)

3104 IRRADIATION EFFECTS ON HASIGUTI PEAKS IN GOLD AND ALUMINUM. Mercier, O. (Univ., Lausanne, Switzerland); Benoit, W.; Moser, P.; Fantozzi, G.; Perez, J.; Gobin, P. (1973). vp.

From fifth international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

Prior to irradiation with electrons at 20°K, aluminum and gold samples were cold-worked (5 or 6% plastic deformation by tensile strain) at 20°K and annealed for one hour at 220 and 270°K, respectively. Gold samples were also irradiated with neutrons at 77°K after plastic deformation of 6% by torsion at 77°K, followed by annealing for one hour at 570°K. The annealing treatments were carried out at temperatures where the modulus defects of the samples are high and therefore the loops of dislocations are large. The Hasiguti peaks disappeared at these temperatures, which means that all the point defects also disappeared. After the irradiations Hasiguti peaks could be observed again, due to point defects caused by irradiation. This seems to confirm the validity of a model given for the Hasiguti peaks which takes into account the interaction between intrinsic point defects and dislocations, as well as the analogy between the recovery mechanism for both materials. (GE)

3105 INFLUENCE OF INTERSTITIAL IMPURITY ATOMS ON POINT-DEFECT RELAXATION IN NEUTRON-IRRADIATED IRON. Weller, M.; Diehl, J. (Max-Planck-Institut fuer Metallforschung, Stuttgart). (1973). vp.

From fifth international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

After low-temperature irradiation with neutrons, the internal friction of iron wires was measured between 80 and 520°K at 1 Hz; the interstitial impurity concentration varied between 1 and 60 wt. ppM N or C. Among the intrinsic point-defect internal friction peaks, which are observed below 300°K, only peak I_{2*}, being assigned to the relaxation of an interstitial configuration, is strongly influenced by impurities. Its suppression with increasing C or N concentration is interpreted as trapping of Fe interstitials and propagating as replacement collision chains at impurity atoms. At temperatures (above 300°K), at which C and N become mobile, the impurities react with remaining point defects, which leads to an additional relaxation peak at approximately 90°C. This peak was studied with respect to kinetics of formation, strength, and activation energy of relaxation, dependence on impurity concentration, and annealing behavior. It is most likely caused by a complex consisting of N and a vacancy. (GE)

3106 SYMMETRY LOWERING OF LATTICE DEFECTS DUE TO ANHARMONIC INTERATOMIC FORCES. Sussmann, J. A. (CEN, Grenoble, France). (1973). vp.

From fifth international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

Interstitials produced by fast-particle irradiation of metals have previously shown to produce a significant reduction of the elastic moduli. An atomic model is proposed that explains the observed effect of the interstitials. It is shown that anharmonic interatomic forces may lead to a lowering of the symmetry of the atomic configuration around the interstitials. The deformability of the interstitials is also taken into account. (GE)

3107 SUBSTRUCTURE OF ALUMINUM SINGLE CRYSTALS GROWN IN A POWERFUL γ FIELD. Danil'chenko, B. A.; Krulikovskaya, M. P. (Inst. of Physics, Kiev). Sov. Phys.-Cryst. (Engl. Transl.); 17: No. 6, 1106-1107(1973).

Translated from Kristallografiya; 17: No. 6, 1262-1264(1972).

Pure (99.996%) Al single crystals were crystallized for one-third of their length with and without irradiation. Subsequent crystal growth was then carried out in the presence or absence of a γ field. The dose rate was 1200 R/s. The following characteristics of substructure were measured: size of macrounits in L_I and L_{II} directions, width of boundaries between macrounits, etch-pit density, disorientation of angles between macrounits, and microhardness. Results show that γ irradiation affects the structure of a liquid during recrystallization and thus affects crystal nucleation. (DLC)

3108 COMMENT ON IRRADIATION-INDUCED EMBRITTLEMENT OF MAGNOX CANS. Schulson, E. M. (Chalk River Nuclear Labs., Ont.). Radiat. Eff.; 19: No. 3, 207(1973).

Reference is made to a suggestion by Gibbs et al., (Radiat. Eff. 16: 267-270(1972)) that the ductility decrease observed after neutron irradiation of Magnox AL 80 (Mg—0.8 wt % Al—0.005 wt % Be) fuel cans is due to the nucleation of creep cavities by inert gas bubbles. Various nuclear reactions were considered, including the (n,α) reaction for lithium present as a trace impurity. The present note points out that two other reactions—the ^{9}Be(n,2n) and the ^{9}Be(n,α) fast-neutron reactions—are expected to lead to a bulk distribution of helium, and that the amount of gas generated after an irradiation time of 1000 days is of the same order as the amount produced by the ^{6}Li(n,α) reaction for a Li impurity level of 0.15 ppM. (UK)

3109 FLUX, DIFFUSION, AND DRIFT. Mosedale, D. (United Kingdom Atomic Energy Authority, Dounreay, Eng.). Radiat. Eff.; 19: No. 3, 205-207(1973).

Previous correspondence on the effect of stress gradients (Mosedale, Radiat. Eff., 14: 281(1972): Hesketh, Radiat. Eff., 16: 141(1972)) is continued. It is stated that Hesketh suggests that stress gradients produce only Kirkendall shifts, whereas the present author contends that creep occurs too. The amount of a mobile species passing through unit area in unit time is called a flux, composed of the sum of the diffusion flux and the drift flux. Equations are developed and boundary conditions defined. The discussion is related to irradiation-produced defects. (UK)

3110 CROSS SECTION OF RADIATION-INDUCED RECOMBINATION OF FRENKEL PAIRS IN PLATINUM. Jung, P. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi (a); 19: No. 1, 213-219(16 Sep 1973).

In polycrystalline platinum samples irradiated by 3.0-MeV electrons to defect concentrations between 1 to 2×10^{-4}, the cross section of defect annealing by subthreshold recoil events was determined. This cross section is strongly changed by successively annealing the samples through stage I. The results signify that defects that anneal through substages I_A and I_B are produced closer to their vacancy than I_C defects. Also, the freely migrating defects must be produced at some distance from the border of the instability volume and only recombine appreciably by subthreshold impact, when they migrated to sites adjacent to the instability volume around the vacancy. (auth)

3111 VOID FORMATION IN ZIRCONIUM UNDER IRRADIATION IN THE HIGH-VOLTAGE ELECTRON MICROSCOPE. Carpenter, G. J. C. (Chalk River Nuclear Labs., Ont.). Radiat. Eff.; 19: No. 3, 189-190(1973).

Experiments were carried out on zirconium foils using 1-MeV electron irradiation. Helium ions were implanted at 58 keV in some specimens at room temperature to a level of 8.8×10^{12} ions/cm^2. During irradiation in the electron microscope, voids were observed in a specimen containing helium, but no voids were seen in specimens free from helium during irradiation for up to 30 min. It is concluded that voids can be produced in zirconium under irradiation provided some insoluble gas is available to stabilize void nuclei. Results are discussed. (UK)

3112 SPUTTERING-YIELD STUDIES ON SILICON AND SILVER TARGETS. Andersen, H. H.; Bay, H. L. (Aarhus Univ., Denmark). Radiat. Eff.; 19: No. 3, 139-146(1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

The sputtering yield of vacuum-deposited silicon and silver targets was measured with 15 different 45-keV ions throughout the periodic system. The dependence of the yield on the projectile atomic number follows rather closely Sigmund's prediction (Phys. Rev.; 184: 383(1969)), especially for silicon. The self-sputtering yield of silver was measured in the 30- to 500-keV energy range. Similar to what is known to be the case for other heavy particles on silver, the maximum of the yield was found to be much more pronounced than predicted by Sigmund's theory. This effect, together with small systematic deviations in the Z_1 dependence, is explained as being caused by nonlinear effects in very dense collision cascades. This point of view is strongly supported by a comparison of the sputtering yield per atom for irradiation with atomic and molecular ions. (auth)

3113 SUBTHRESHOLD RADIATION EFFECTS IN PLATINUM. Chaplin, R. L.; Jung, P. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi (a); 19: No. 1, K31-K34(16 Sep 1973).

Calculations of the effects of electron bombardment at 1.7 MeV on orientation of Frenkel pairs revealed that these pairs have a Gaussian-like distribution around the irradiation direction, with a half-width of about 40°. Experiments were conducted using pure Pt targets for 1.7 and 1.15 electron beams at 45° relative to the surface of the Pt. The specimens were also irradiated using an angular distance of 90° between the 1.7- and 1.15-MeV beams. Results of these irradiations show that the reactions of Frenkel pairs are isotropic. (JRD)

3114 PHASE TRANSFORMATIONS AT BOMBARDMENT OF Al AND Fe POLYCRYSTALLINE FILMS WITH B^+, C^+, N^+, P^+, AND As^+ IONS. Pavlov, P. V.; Zorin, E. I.; Tetelbaum, D. I.; Lesnikov, V. P.; Ryzhkov, G. M.; Pavlov, A. V. (Physical-Technical Research Inst., Gorky, USSR). Phys. Status Solidi (a); 19: No. 1, 373-378(16 Sep 1973).

The phase composition of aluminum films after bombardment with boron, carbon, nitrogen, phosphorus, and arsenic ions is investigated by the electron-diffraction method. It is shown that in all the cases except of bombardment with B^+ ions the known compounds of aluminum with the indicated species are formed. The phase formed as a result of B^+ bombardment could not be identified with the known aluminum borides. It is shown that the texture of the formed phases is determined by the texture of the initial aluminum films indicating the epitaxial (or endotaxial) character of growth of these phases. In some cases AlP and AlAs phases are formed in an amorphous state. This is explained by insufficient substrate temperature for the crystallization or by amorphization under ion beam action. It is further shown that at bombardment of α-iron films with C^+ ions ϵ-carbide is formed which after annealing at $T \geqq 300$°C transforms into cementite. (auth)

3115 NECESSARY CONDITION FOR THE APPEARANCE OF DAMAGE-INDUCED SURFACE-TOPOGRAPHY DURING PARTICLE BOMBARDMENT. Hermanns, N. (Univ., Brussels). Radiat. Eff.; 19: No. 3, 161-169(1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

A first approach to the establishment of an "order-of-magnitude" criterion for the initiation of damage-induced surface topography on clean and well-polished metal single crystals is proposed. It is based on a model proposing a mechanism of preferential erosion of parts from the sample surface due to a local increase of sputtering yield above "extensive defects". These "extensive defects", resulting from the migration of the point defects, created during the collision cascade started by the incoming ions, can indeed influence the sputtering yield if they are located close under the surface, i.e., when the surface has regressed, due to sputtering, to the level where these "extensive defects" have been formed. The condition implies that the formation of "extensive defects" must have taken place before the surface reaches them. The condition is written in terms of the irradiation parameters and quantities characteristic for the migration of point defects due to the presence of a potential gradient related to the "extensive defects" under formation. (auth)

3116 EFFECT OF MINOR ALLOY VARIATIONS ON THE THERMAL DENSIFICATION OF AUSTENITIC STAINLESS STEELS. Bates, J. F.; Paxton, M. M.; Straalsund, J. L. (Westinghouse Hanford Co., Richland, WA). Nucl. Technol.; 20: No. 2, 134-136(Nov 1973).

Increasing the carbon content of AISI Type-316 stainless steel can produce density changes >0.1% after aging at 1500°F for 100 h. Large additions of phosphorus (0.04 wt %), boron (0.006 wt %), and nitrogen (0.13 wt %) produce no significant density change upon aging. It was concluded that the thermal densification phenomenon observed in austenitic stainless steels is due to the formation of carbides and is linear with the carbon content of the alloy. (auth)

Other Materials

Refer also to abstracts 3013–3016, 4721, 4730, 4732, 4735, 4742, 4743, and 4771.

3117 (GEPP-111) FINITE ELEMENT VISCOELASTIC STRESS ANALYSIS STUDY USING THE GENERALIZED KELVIN SOLID MODEL. Spears, R. K. (General Electric Co., St. Petersburg, Fla. (USA). Neutron Devices Dept.). 17 Oct 1973. Contract AT(29-2)-656. 43p. Dep. NTIS $4.25.

Both filled and unfilled polymers are used extensively in the construction of neutron generators. These materials are used for environmental protection, high-voltage hold-off and, in some cases, to carry high-intensity dynamic stress waves. Reliability requirements, requires knowledge of how polymerization shrinkage stresses, thermal expansion stresses, and operational stresses affect their performance. To incorporate the effect of stress relief, several references on the treatment of viscoelastic materials were examined. The initial method studied was taken from a paper by Zienkiewicz et al. The program was checked against a theoretical model consisting of uniaxial loading of a prismatic solid. The resulting answer given as equilibrium creep strain, differed by 25%. (auth)

3118 (JUL-959-RW) GRAPHITIZATION OF POLYCRYSTALLINE CARBONS UNDER IRRADIATION WITH FAST NEUTRONS. Haag, G. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe). Jun 1973. 130p. (In German). Dep. NTIS (U. S. Sales Only) $8.50.

Experimental results are given on the significance of noncrystalline carbon for the behaviour of polycrystalline graphitic materials under irradiation with fast neutrons to fluences up to $5 \times 10^{21}/cm^2$ (EDN) at irradiation temperatures between 500 and 1,400°C. Besides the influence of several production parameters on the dimensional behavior of HTR fuel element matrix artefacts, it was observed for the first time that at high irradiation temperatures the thermal conductivity may increase in spite of increasing fluence, probably as a consequence of graphitization under irradiation of the nongraphitic carbon component. 59 figures, 62 references. (GE)

3119 (SRARI-P-188) RADIATION DAMAGE OF DISPERSION COMPOSITIONS. Ol'khovikov, V. A.; Gol'tsev, V. P.; Korchagin, A. S.; Chechetkina, Z. I. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The performance of dispersion compositions as that of the summation of interindependent spherical cells is considered. For a separate cell a problem is solved on temperature stress and strain distributions regarding the initial porosity and swelling of the component materials. A quantitative estimation of the effect of damaged matrix fraction on the total composition stability is proposed. The particle size effects on the strength are estimated from the strain intensity. The ability to work of the dispersion fuels having various fractional compositions is estimated. (auth)

3120 POLYMER-IMPREGNATED FIBROUS MATERIALS. The Resistance of Polymer–Wood Composites to Chemical Corrosion. Spindler, M. W.; Pateman, R.; Hills, P. R. (United Kingdom Atomic Energy Authority Research Group, Harwell, Eng.). Composites; 4: No. 6, 246-253(Nov 1973).

The resistance to chemical attack of polymer composites (formed by impregnating timber with liquid monomers which are subsequently polymerized in the interstices of the wood by high-energy radiation) based on ash, birch, elm, and maple was evaluated for a representative range of corrosive reagents. The behavior of these composites was compared with that of the untreated parent timbers, and with teak and iroko which have a high natural resistance to corrosion. The chemical resistance of composites is generally 2 to 5 times greater than that of untreated timbers. (auth)

3121 CRYSTAL-FIELD STUDIES OF SOME RARE EARTH HYDROXIDES. Kumar, V. (D.B.S. Coll., Dehradun, India); Gupta, G. K.; Dass, N.; Chandra, K. Phys. Status Solidi (b); 59: No. 2, 607-613(1 Oct 1973).

The magnetic susceptibility, μ_{eff}, and the Schottky specific heat were calculated over a temperature range 10 to 300°K in Er(OH)$_3$, Er^{3+} : Y(OH)$_3$, Dy(OH$_3$, and Ho^{3+} : Y(OH)$_3$ systems. The spectroscopic splitting factors, Curie constants, and extra entropy associated with the Schottky anomaly were compared with experimental results. By reason of the good agreement it was concluded that the crystal electric field parameters used are significantly accurate. (auth)

3122 EPR INVESTIGATION OF PARAMAGNETIC CENTERS IN β-RHOMBOHEDRAL BORON. Gewinner, G.; Kubler, L.; Koulmann, J. J.; Jaegle, A. (Centre Univ. de Haut Rhin, Mulhouse, France). Phys. Status Solidi (b); 59: No. 2, 395-402(1 Oct 1973).

A symmetrical EPR line with a g-factor of 2.0028 is observed in β-rhombohedral boron at temperatures above 300°K. The spin density is measured in the range 300 to 1000°K. It increases exponentially with the temperature and an activation energy of about 0.40 eV is obtained. The line width exhibits a minimum in the neighborhood of 450°K. These results suggest a carrier model with localized wave functions. The number of corresponding electronic states is very large. In the neighborhood of 300°K, the line width, line shape, and g-value are within experimental errors the same as those reported for the EPR line observed under illumination with a radiation of about 0.8 μm. The two EPR spectra may thus be attributed to the same electronic states being occupied either by optical or by thermal excitation. Measurements of line width and spin density for the photo-induced EPR line between 77 and 300°K are reported and support this hypothesis. (auth)

3123 TEMPERATURE DEPENDENCE OF HYPERFINE STRUCTURE COUPLING PARAMETERS OF CO_2^- AND AsO_3^{2-} MOLECULE IONS IN γ-IRRADIATED SINGLE-CRYSTAL CALCITE. Chan, S. S.; Marshall, S. A.; Serway, R. A. (Argonne National Lab., IL). Phys. Status Solidi (b); 59: No. 2, 687-692 (1 Oct 1973).

The hyperfine structure coupling parameters of CO_2^- and AsO_3^{2-} molecule ions in γ-irradiated single crystal calcite were measured from 4.2 to 325°K. For CO_2^-, the data suggest that the fractional electron spin density at the carbon atom increases by about 1% on raising the temperature from 4.2 to 200°K. For the AsO_3^{2-}-molecule ion, the fractional electron spin density on the arsenic atom decreases by about 7% on raising the temperature from 4.2 to 325°K. (auth)

3124 Ag_2^+ MOLECULAR IONS IN A KCl CRYSTAL. Zhitnikov, R. A.; Baranov, P. G.; Melnikov, N. I. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Status Solidi (b); 59: No. 2, K111-K114(1 Oct 1973).

Results of studies on Ag_2^+ molecular ions in x-irradiated KCl: Ag crystals are presented. Experimental data are presented which show that the most plausible model of an Ag_2^+ center consists of two Ag$^+$ ions acting as an electron trap and occupying one cationic lattice site. (JRD)

3125 CHANGES IN STRENGTH CHARACTERISTICS OF GRAPHITE SUBJECTED TO NEUTRON IRRADIATION. Platonov, P. V.; Virgil'ev, Yu. S.; Karpukhin, V. I.; Zaitsev, A. L.; Novobratskaya, I. F. At. Energ. (USSR); 35: No. 3, 169-172(Sep 1973). (In Russian).

The kinetics of changes in strength characteristics for various grades of graphite subjected to neutron irradiation was investigated. Temperature dependences of steady compressive strength and the elastic modulus were obtained. The strength of materials is observed to increase appreciably during low-temperature irradiation and to decrease gradually with increasing temperature. The compressive strength of graphite at temperatures higher than 900°C is equal to the initial value. Experimental dependences between shape, variations and strength characteristics of graphite are described. (auth)

3126 EPR STUDY OF Zn$^+$ IN CALCITE. Popescu, F. F.; Grecu, V. V. (Univ., Bucharest). Solid State Commun.; 13: No. 7, 749-751(1 Oct 1973).

The EPR spectrum of Zn$^+$ in γ-irradiated calcite is reported.

The large hyperfine splitting and the high isotropy of g and hyperfine interaction tensors ($g_{||}$ = 2.0008 ± 0.0002; $g_{\perp}$ = 1.9965 ± 0.0002; $A_{||}$ = 515.5 ± 0.2 G; $A_{\perp}$ = 505.3 ± 0.2 G) are consistent with the $(4S)^1$ electron configuration of Zn^+. The large reduction of the hyperfine constant (free-ion value 880 G estimated from the isoelectronic series) is explained by covalency effects. (auth)

3127 RADIO AND THERMOLUMINESCENCE STUDIES IN CsI DOPED WITH F CENTERS. Pellaux, J. P.; Sidler, T.; Nouailhat, A.; Aegerter, M. A. (Neuchatel Univ., Switzerland). Solid State Commun.; 13: No. 7, 979-981(1 Oct 1973).

Radioluminescence, thermoluminescence, and uv excitation measurements in CsI additively colored crystals show a new luminescent component located at 2.5 eV. This is attributed to the radiative recombination of V_k centers with F centers. Another new component at 2.72 eV is observed only under uv excitation of 5.14 eV. This is related to the radiative recombination of localized excitons at F^+ center sites (α band). (auth)

3128 APPARATUS FOR PRODUCING STICKS OF SOLID DEUTERIUM. Krause, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). J. Phys., E (London); 6: No. 11, 1132-1134(Nov 1973).

An apparatus for producing sticks of solid hydrogen and deuterium in high vacuum, for use as targets in laser-plasma experiments, is described. The sticks are of square cross section (2mm × 2mm) and are up to 15 cm in length. (auth)

3129 PROPERTIES AND DESIGN CRITERIA OF OPTICAL THIN FILMS. Lee, S. S. New Phys. (S. Korea); 12: No. 3, 98-104(Sep 1972). (In Korean).

The physical optics of dielectric thin films of extremely low optical absorption coefficient is presented. The basic electromagnetic theory of optical absorption is reviewed. Then the theory is extended to derive expressions for field and thin-film matrices in the multilayer system. The thin-film approximation, high reflectivity system, and interference filter are treated. Materials for optical thin films and the method of film preparation are discussed. The paper also briefly discusses metallic thin films of high attenuation but low absorption coefficient. (TTT)

3130 GROWTH KINETICS OF F CENTERS AND THERMOLUMINESCENCE OF RUBIDIUM HALIDES. Radhakrishna, S.; Narayanan, R. (Indian Inst. of Tech., Madras). Phys. Status Solidi (a); 19: No. 1, 103-109(16 Sep 1973).

Measurements were made on the growth of the F band with x-irradiation time at room temperature on RbCl and RbBr crystals. The first stage of the F-center growth curve has been found to consist of at least three substages. Thermoluminescence studies show two peaks at 85 and 110°C in RbCl which have been attributed to F-centers. In Cd-doped crystals an additional peak at 145°C has been observed which has been assigned to centers involving cadmium. This assignment has been supported by the results on EPR of these crystals which give a hyperfine structure constant of ≈3600 G. Additive coloration of Cd-doped crystals also yields the Cd^+ band due to the capture of electrons by Cd^{2+}. (auth)

3131 ACTINIDE TETRAFLUORIDE LATTICE PARAMETERS. Asprey, L. B.; Haire, R. G. (Los Alamos Scientific Lab., NM). Inorg. Nucl. Chem. Lett.; 9: No. 11, 1121-1128 (Nov 1973).

Reference is made to earlier determinations of the lattice parameters of the actinide tetrafluorides and some inconsistencies are pointed out. A comparison of the parameters recently obtained for CfF_4 with values for BkF_4 indicated that the two sets of dimensions were not compatible. Deviation of the BkF_4 parameters from the trend shown for the tetrafluorides from Th to Cm was also noted. Subsequent calculations have provided a revised set of parameters for the tetrafluorides from Th to Bk, and these new values are reported and compared with earlier values. Details are given of the experimental work, and results are tabulated and discussed. The values reported are believed to be the best values at present for these compounds and provide a self-consistent set of dimensions for the series. The values of the three linear parameters converge towards a limit in the region of CfF_4, with the b_0 parameter showing the least change for element in the latter part of the series. It appears that it will not be possible to obtain experimental lattice parameters for the higher members of the actinide series at present, for reasons given. The data presented were obtained using the powder method, and single-crystal data are needed to verify the values reported. (UK)

3132 DISLOCATION LOOPS INDUCED BY ELECTRON IRRADIATION OF POTASSIUM CHLORIDE AT LOW TEMPERATURES. II. Region Between −110 and +20°C. Kawamata, Y. (Tohoku Univ., Sendai). Phys. Status Solidi (a); 19: No. 1, 331-334(16 Sep 1973).

Dislocation loops of Burgers vectors (a/2) $\langle 011\rangle$ form in potassium chloride during examination at temperatures of −110 to 20°C in a 75-kV transmission electron microscope. In addition to these loops, dislocation loops whose character is not known well yet and dislocation loops of a Burgers vector of the type a[001] also form at a temperature higher than about −15 and −5°C, respectively. The third type of loops is transformed into cracks when they have developed. (auth)

3133 DIRECTIONAL EFFECTS AS OBSERVED BY THE CHANNELING-EFFECT TECHNIQUE IN ION-INDUCED RADIATION DAMAGE IN GaAs. Boettiger, J.; Whitton, J. L. (Chalk River Nuclear Labs., Ont.). Radiat. Eff.; 19: No. 3, 201-202 (1973).

Using the channeling effect technique to measure radiation damage in GaAs, differences of up to a factor two were observed in the total amount of damage in Kr-implanted GaAs when measured along the two different directions ($\langle 111\rangle/\langle 110\rangle$). The experiments are described and results discussed. Implantations and subsequent He^+ backscattering analyses were done with the target at 25°K. After annealing at room temperature, nearly 80% of the damage (as measured along the $\langle 110\rangle$) had annealed away and the anisotropy had largely disappeared. (UK)

3134 DEUTERON-INDUCED DAMAGE IN ALKALI HALIDES. Price, P. B.; Williams, J. S.; Kelly, J. C. (New South Wales Univ., Kensington, Australia). Radiat. Eff.; 19: No. 3, 203-204 (1973).

Initial deuteron-damage measurements were made in NaCl and KCl, and results are compared with previously reported measurements of proton and helium irradiation damage in alkali halides. A 1-MeV deuteron beam was incident on the target crystals in the $\langle 100\rangle$ direction. A solid-state detector, placed at 160° to the incident beam direction, detected the backscattered deuterons. Results are presented and discussed. (UK)

3135 ^{19}F NUCLEAR MAGNETIC RESONANCE IN γ-IRRADIATED LiF. Van den Berghe, E. V. (Univ., Ghent); Van den Bosch, A. Radiat. Eff.; 19: No. 3, 199-200(1973).

Nuclear magnetic resonance investigations of lithium fluoride single crystals, subjected to neutron doses of the order of 1 × 10^{18} n/cm², revealed the presence of fluorine molecules in the crystals. The formation of molecular fluorine is discussed in the light of the collision theory dealing with the creation of Frenkel defects by elastic collisions of the α and tritium particles with lattice atoms. Ionizing radiation, however, is also able to produce lattice defects in alkali metal halides. The radiation damage induced by γ rays in LiF crystals is found to be strikingly similar to that induced by neutrons. In the present paper this similarity finds additional confirmation by the evidence given for the formation of molecular fluorine in γ-irradiated single crystals of lithium fluoride. (UK)

3136 IMPLANTATION ANGLE INFLUENCE ON PENETRATION OF BORON CHANNELED IONS INTO SILICON. Gverdtsiteli, I. G.; Guldamashvili, A. I.; Diasamidze, E. M.; Zaslavskii, S. A.; Kalinin, A. N.; Kumakhov, M. A.; Muralev, V. A. (Physical-Technical Inst., Sukhumi, USSR). Radiat. Eff.; 19: No. 3, 171-174(1973).

Experiments on the dependence of penetration of boron ions channeled into silicon are described. (auth)

3137 INCREASE OF GOLD–TEFLON FEP JOINT STRENGTH BY ELECTRON BOMBARDMENT. Sessler, G. M.; West, J. E.; Ryan, F. W.; Schonhorn, H. (Bell Telephone Labs., Murray Hill, NJ). J. Appl. Polym. Sci.; 17: No. 10, 3199-3209(Oct 1973).

The strength of joints between Teflon FEP (Type A) and 500- to 1000-Å gold layers deposited by evaporation can be greatly increased if the Teflon surface is subjected to electron-beam bombardment prior to the evaporation process. Typically, joint strengths of about 60 kg/cm², approaching the bulk strength of Teflon, are obtained for treatments with electron-beam energies in the range of 5 to 20 keV and intercepted charge densities of about 5 × 10^{-6} C/cm². This compares with gold/Teflon joint strengths of about 10 kg/cm² for untreated material. The increase in joint strength is believed to be primarily due to crosslinking caused by the electron bombardment. Compared to the other known treatments to improve gold/Teflon joints, the present method has the advantage that the charge-storage properties of the Teflon are not irreversibly degraded. It is possible, for example, to store charge densities up to 3 × 10^{-6} C/cm², on 25-μm films treated with this method, with the same favorable charge-retention properties and thermally stimulated current characteristics as obtained for untreated Teflon. (auth)

3138 MOS THRESHOLD SHIFTING BY ION IMPLANTATION. Sigmon, T. W.; Swanson, R. (Hewlett-Packard Co., Palo Alto, CA). Solid-State Electron.; 16: No. 11, 1217-1232(Nov 1973).

The theoretical description of threshold shifting of MOS devices by implantation of an impurity beneath the control electrode is presented. Experimental measurements are presented which verify the theoretical predictions. In particular, MOS capacitors and transistors were used to experimentally verify the theory (n-type Si substrates to verify the case of p-channel devices). Implanted layers sufficient to compensate the background substrate doping were used. This layer creates a buried conducting channel beneath the gate that is isolated from the substrate by the p−n junction. Modulation of this conduction region by the surface depletion region was found to be responsible for the transistor action. For n-type substrates (p-channel devices), ion energies of 33 and 53 keV were selected for use with gate oxides of ~0.1 μm. Boron doses ranged from 5×10^{10} to 2×10^{12} atoms/cm^2. Threshold shifts from 0.2 to 5 V were observed. Device performance was not degraded by the implantation. Annealing temperatures as low as 500°C were found to be sufficient to anneal the damage caused by the implantation. Changes in the characteristic C vs V curves of the devices were predicted and experimentally observed. A method of picking the approximate turnoff voltage of the devices from the C vs V curves is pointed out. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstract 3681.

3139 (RFP-2105) STUDIES WITH A PASSIVE Ge(Li) ASSAY SYSTEM. Martin, H. R.; Chanda, R. N. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 1973. 4p. (CONF-731101-23). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The use of passive Ge(Li) gamma-ray waste/scrap assay systems for material accountability at Rocky Flats is briefly discussed. (WHK)

3140 CALIFORNIUM-252 ASSAY SYSTEM FOR FBR-TYPE FUEL PINS. Menlove, H. O.; Forster, R. A.; Parker, J. L.; Smith, D. B. (Los Alamos Scientific Lab., NM). Nucl. Technol.; 20: No. 2, 124-133(Nov 1973).

A hybrid assay system utilizing both active and passive techniques has been built for the measurement of the plutonium fissile content in fast-breeder-reactor-type fuel pins. A moderated ^{252}Cf source (~600 μg) is used for the neutron interrogation of the fuel rods, and the fissile content is then determined by counting the high-energy delayed gamma rays resulting from the induced fission reactions. Neutron transport calculations using both S_n and Monte Carlo techniques were used to design the ^{252}Cf neutron tailoring assembly to give an intense fast-neutron irradiation, as well as a high fissile/fertile fission ratio. In addition to the total fissile active assay, pellet-to-pellet uniformity is determined simultaneously by counting the lower energy passive gamma rays from the fuel using the same NaI detectors. The complete assay system, which includes automated fuel-rod handling and data reduction, is being used for in-plant measurements of Fast Flux Test Facility fuel pins. (auth)

3141 NUCLEAR DATA FOR SAFETY SYSTEMS. Yan'kov, G. B. (Inst. of Atomic Energy, Moscow). pp 40-49 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From All-Union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The technical methods of nuclear fuel control for a safeguard system are listed, and the needs in nuclear data to develop and modernize such methods are briefly discussed. (4 figures) (auth)

Disposal and Storage

Refer also to abstracts 2641 and 4525.

3142 (ORNL-TM-4381) ROCK DEFORMATIONS RESULTING FROM PROJECT SALT VAULT. McClain, W. C. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 49p. Dep. NTIS $4.50.

Following the completion of the Project Salt Vault experiment on the disposal of radioactive waste in an underground salt mine, a final report was prepared. That report presented the results and analysis of the extensive rock deformation measurement newwork. Since that time, deformation measurements have continued so that the results from a total time approaching 10 years is now available. Analysis of this extended data base, including re-examination of experimental period, is presented in this document. This analysis confirmed many aspects of the earlier one and served to considerably broaden the general understanding of the long-term consequences of the application of heat in an underground salt formation. (auth)

3143 STORAGE CAPACITY FOR FISSILE MATERIAL AS A FUNCTION OF FACILITY SIZE. Schuske, C. L.; Altschuler, S. J. (Dow Chemicals, Golden, CO). Nucl. Technol.; 20: No. 3, 179-189(Dec 1973).

A model was developed which relates the surface density (liter/ft^2, kg/ft^2) for enriched uranium and plutonium in a storage facility with its physical size. Calculations indicate that the allowable surface density for a small storage facility can be significantly increased over that for a large facility. A much higher total loading can be achieved for a given floor area by grouping several small adjacent storage rooms, each separated by a 1-ft-thick concrete wall, into a larger structure. This type of approach would need to be weighed against the added cost of 12-in.-thick interior concrete walls necessary to provide neutron isolation between adjacent rooms for a practical plant design. (auth)

3144 MANAGEMENT OF RADIOACTIVE AQUEOUS WASTES FROM AEC FUEL-REPROCESSING OPERATIONS. Lennemann, W. L. (Atomic Energy Commission, Washington, DC). Nucl. Safety; 14: No. 5, 482-506(1973).

Since 1944 the U. S. Atomic Energy Commission (and its predecessor, the Manhattan District) has been overseeing the management of radioactive wastes from its fuel-reprocessing plants which are contractor operated. Experience during the years has indicated that management of these radioactive wastes requires unrelenting evaluation and appraisal by higher management and management groups. Experience with leaking waste tanks at Hanford, Savannah River, and the National Reactor Testing Station to 1972 is summarized. Important related activities are periodic reviews, frequent analyses, and continuous planning. Guidance is provided for designers of fuel-reprocessing waste-management systems including such features as acid waste storage, double containment, protection against credible forces of nature, facilities for emptying waste-storage tanks, space and accesses for inspection, adequate radiation-monitoring devices connected to a central recording station, and segregation and diversion capability for discharged effluent aqueous streams. (auth)

3145 METHOD FOR STORING RADIOACTIVE COMBUSTIBLE WASTE. Godbee, H. W.; Lovelace, R. C. (to United States Atomic Energy Commission). US Patent 3,764,552. 9 Oct 1973. Filed date 14 Jun 1972. 4p.

A method is described for preventing pressure buildup in sealed containers which contain radioactively contaminated combustible waste material by adding an oxide getter material to the container so as to chemically bind sorbed water and combustion product gases. (Official Gazette)

Handling Equipment and Procedures

Refer also to abstract 2819.

3146 (AP-40(2nd Ed.)) AIR POLLUTION ENGINEERING MANUAL. Second Edition. Danielson, J. A. (Comp. and ed.). (Environmental Protection Agency, Research Triangle Park, N. C. (USA)). May 1973. 987p. GPO.

The results of scientific and engineering studies conducted in Los Angeles County, Calif. in the field of air pollution are compiled and reported. Individual and cooperative studies were undertaken in conjunction with state and local agencies, research institutes, and industrial organizations. The subjects covered include: air contaminants; design of exhaust systems; air pollution control equipment for particulate matter; control equipment for gases and vapors; metallurgical equipment; mechanical equipment; incineration; combustion equipment; petroleum equipment; chemical processing equipment, including radioactive materials processing equipment; and organic solvent emitting equipment. Twenty pages of references, five appendixes, and a subject index are included. (LCL)

3147 (GULF-GA-A-12272) SPENT FUEL SHIPPING, REPROCESSING, AND RECYCLE FABRICATION IN THE HTGR FUEL CYCLE. Brooks, L. H.; Davis, C. R.; Peterman, D. D.; Spaeth, M. E. (Gulf General Atomic Co., San Diego, Calif. (USA)). 15 Dec 1972. Contract AT(04-3)-167. 8p. (CONF-730918-2). Dep. NTIS $3.00.

From joint power generation conference; New Orleans, Louisiana, USA (16 Sep 1973).

The High Temperature Gas Cooled Reactor (HTGR) fuel recycle operation is described. The description includes the HTGR spent fuel shipping system and the proposed method of reprocessing the spent fuel to recover the bred ^{233}U and ^{235}U. The process for refabricating the recovered fuel into recycle fuel is also discussed. (auth)

3148 (RFP-Trans-139) INDIVIDUAL MEANS OF PROTECTION DURING OPERATION IN "HOT" LABORATORIES. Goroginski, S. M.; Scherbakol, V. L. (Institut Biofiziki, Moscow (USSR)). Aug 1963. Translated from Report SM-125/26. (CONF-691008-19; SM-125/26). 13p. Dep. NTIS $3.00.

From symposium on radiation problems in the design and operation of "hot" facilities; Saclay, France (13 Oct 1969).

In order to design personal protective facilities for use in "hot" laboratories one must first specify the requirements to be met by such facilities and formulate a set of medical and technical standards relating to physiological changes in the organism of the wearer. On the basis of a variety of studies it is now possible to recommend standard indices relating to the efficiency of protective facilities, to the content in breathing mixtures of a number of human vital-activity products, and to the functional condition of the wearer. Protective facilities (pressurized suits, coveralls, respirators, etc.) which meet the recommended standards are produced in the Soviet Union. When contaminated, protective facilities can themselves become a secondary source of significant air and surface contamination in areas adjacent to "hot" cells; hence the need to combine the use of protective facilities with that of air locks incorporating changing rooms in which the protective facilities can undergo preliminary decontamination and personnel can be given preliminary medical examinations. An air lock of this kind and the use of air locks in combination with personal protective facilities are described. (auth)

3149 (Y-CDC-12) REVIEW OF THE EXPERIMENTS PERFORMED TO DETERMINE THE RADIOLOGICAL CONSEQUENCES OF A CRITICALITY ACCIDENT. Lecorche, P.; Seale, R. L. (Oak Ridge Y-12 Plant, Tenn. (USA)). 3 Nov 1973. Contract W-7405-eng-26. 44p. Dep. NTIS $5.45.

The series of nuclear criticality excursions in aqueous solutions of uranium highly enriched in the ^{235}U isotope, conducted by the Service d'Études de Criticité of the French Commissariat à l'Energie Atomique from 1968 through 1971, are summarized. A total of 40 excursions were observed under a wide range of solution concentrations and ramp reactivity insertions. Results for the pulse trains that developed include determination of peak fission rates, pulse widths, integrated yields, and consequent gamma-ray dose rates. The analysis of these results suggests the strong influence of gas evolution, as well as temperature, as a mechanism limiting pulse size. (auth)

3150 DEVICE FOR ENCAPSULATING A RADIOACTIVE RESIN-WATER SLURRY. Kucherer, H. D. US Patent 3,749,917. 31 Jul 1973. Filed date 12 May 1971. 4p.

A device and process are described wherein a metallic drum is lined with a layer of cement and vermiculite and evacuated. An injection header is fitted to and extends into the hollow interior of the lined drum to permit access of radioactive waste comprising a resin-water slurry. The hollow interior of the drum may fill with resins while the cement-vermiculite layer uniformly absorbs the water therefrom. (Official Gazette)

Transportation

3151 (ORNL-TM-4357) LMFBR SPENT FUEL TRANSPORT: A LiOH–NaOH NEUTRON-THERMAL SHIELD FOR SPENT FUEL SHIPPING CASKS. Irvine, A. R.; Shappert, L. B. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 35p. AT.

The neutron shield system described reduces the neutron dose rate around a shipment of spent LMFBR fuel and, in addition, affords protection against damage of the shipment by fire. Fire protection is afforded by means of an insulation that remains effective until a predetermined cask temperature is reached and by means of a substantial heat sink. After the predetermined cask temperature has been attained, the neutron shield system serves as a good heat conductor. Calculations indicate that a steel-shielded cask carrying short-decay fuel assemblies and equipped with this type of neutron shield could readily survive a 1475°F fire of 10-h duration. Calculations are in part confirmed by experimental results. (auth)

3152 INTERNATIONAL CONVENTION CONCERNING THE CARRIAGE OF GOODS BY RAIL (CIM). Annex 1. International Regulations Concerning the Carriage of Dangerous Goods By Rail (RID). Fifth Edition. London; Her Majesty's Stationery Office (1973). 405p.

The Regulations cover seven classes of substances, of the following general types: explosives; spontaneously combustible substances; inflammable substances; poisonous substances and radioactive substances; corrosive substances; substances liable to cause infection; organic peroxides. Among a number of appendices, one is entitled: tables, methods for the application of criteria of Nuclear Safety Class I and test methods for packagings intended for radioactive substances. (UK)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 3920.

3153 (LA-5439-PR) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Report for the Period Ending July 31, 1973. Dunn, E. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 47p. Dep. NTIS $4.00.

Effort this quarter has been devoted to the combination of shield stacking, component installation, and electrical hookup in the experimental area. Beam was successfully delivered to Area B through the switchyard and work is rapidly reaching that stage of completion necessary for the first delivery of beam to Area A. During this report period, LAMPF received about 33 visiting staff and guest scientists and about 48 users who will be at LAMPF during the summer months. Housing was obtained for all summer visitors who requested accommodations. The long-term visiting staff and guest scientists in residence now number 25 and the long-term users number 18. (auth)

3154 (RFP-2098) PERSONAL ALPHA COUNTER WITH AURAL READOUT. Tyree, W. H.; Bell, T. H. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 1 Nov 1973. Contract AT(29-1)-1106. 8p. Dep. NTIS $4.00.

An alpha counter has been developed for use by production operations personnel working in nuclear facilities where contamination control of radioactivity must be carefully exercised. The counter, worn or carried, provides monitoring capability whenever an operator requires its use. The system for the counter uses a standard Rocky Flats air-proportional detector, a charged energy-storage capacitor, and a low power electronic circuit to operate an aural indicator. The alpha-particle counting capability in the system has been achieved at minimum costs. (auth)

3155 (RL-73-106) RADIATION PROTECTION IN PARTICLE ACCELERATOR AREAS. Post-Graduate Radiological Protection Course Lecture Notes. Perry, D. R. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Oct 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

An account is given of radiation hazards associated with particle accelerators under three heads: primary (accelerated) beams, secondary radiations and induced radioactivity. The nature and importance of the hazard in each case is described. Radiation dose rates, and the principles of dosimetry are discussed, with special reference to the problem of pulsed radiation. Examples are given of problems which arise in accelerator radiation protection and dosimetry and some methods used to overcome them, under the following heads: electron accelerators up to 20 MeV, heavy particle accelerators up to 100 MeV, high energy (100 MeV to 1 GeV) electron and proton accelerators. (UK)

3156 STATUS REPORT OF THE GARCHING ERA EXPERIMENT. Andelfinger, C. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Particle Accel.; 5: No. 2, 105-111(1973).

The first Garching electron experiment was completed last spring. The results are electron rings, compressed in 9 μsec, with electron numbers of 5×10^{12} and holding powers of about 15 MV/m. In the meantime a new experimental arrangement consisting of one single-turn coil has been set up. The injection system was improved by a self-made field emission tube, delivering an electron current of 270 A through the snout. (auth)

3157 EXPERIMENTS ON ELECTRON RINGS AT BERKELEY. Lambertson, G. R.; Chupp, W. W.; Faltens, A.; Hartwig, E. C.; Herrmann, W. J.; Keefe, D.; Laslett, L. J.; Peterson, J. M.; Rechen, J. B.; Salop, A. (Univ. of California, Berkeley). Particle Accel.; 5: No. 2, 113-120(1973).

During the past year or so experimental and theoretical work at Berkeley has been mainly concerned with trying to achieve, in a controlled and understandable way, compact high-intensity rings with high holding power. Enough problems with instabilities and other collective effects that cause degradation in ring quality have been observed in a variety of compressor configurations that we have been reluctant to attempt ion-acceleration experiments before having a good grasp of the phenomena limiting the attainment of high-quality rings. The present status of the equipment and experimental results are described, and the theoretical and experimental observations that are relevant to the formation of high-quality rings and that led to the evolution of the present equipment are discussed. (auth)

3158 PROSPECTS FOR THE DEVELOPMENT OF NEW COLLECTIVE METHODS OF ACCELERATION. Rabinovich, M. S.; Tsytovich, V. N. (Lebedev Inst. of Physics, Moscow). Particle Accel.; 5: No. 2, 99-103(1973).

The future of new collective methods of acceleration is discussed. For beam coherent acceleration the possibility is emphasized of longitudinal ring stabilization by using the transitional radiation. For impact acceleration a transient compressor is proposed. Acceleration by nonlinear waves and solitons in relativistic electron beams is considered in more detail. (auth)

3159 ACCELERATION OF CHARGED PARTICLES BY INTENSE ELECTRON BEAMS. Yonas, G. (Sandia Labs., Albuquerque, NM). Particle Accel.; 5: No. 2, 81-91(1973).

Several groups have observed that energetic ions are accelerated in the direction of the electron flow in vacuum and plasma filled diodes, as well as in electron beams propagating in low pressure neutral gases. Ion energies many times the electron energy and accelerating fields of 1 MV/cm have been measured. In all of these experiments, background gas ions are accelerated at the same time that the electron beam self pinches. Several models have been advanced to explain the acceleration of an ion bunch in such high intensity electron beams. The results of the experiments are reviewed in terms of coherent and collective acceleration models, with particular emphasis placed on collective acceleration in a propagating potential well. (35 references) (auth)

3160 PARTICLE ACCELERATION BY ELECTRON BEAMS. Kolomenskii, A. A. (Lebedev Inst. of Physics, Moscow). Particle Accel.; 5: No. 2, 73-79(1973).

A brief review is given of basic ideas in the field of collective methods of particle acceleration by means of electron beams. In particular, methods proposed in recent times of acceleration in "straight" and in closed-circuit, cyclical beams are considered. Attention is directed primarily to the physical peculiarities of the various methods and to problems to be solved before they can be realized. (auth)

3161 HEAVY-CURRENT ELECTRON ACCELERATOR FOR PHYSICS RESEARCH. Gerasimov, V. F.; Lepnikov, V. F.; Pevzner, M. I.; Chernoplekov, N. A. (Inst. of Atomic Energy, Moscow). pp 201-209 at Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From All-Union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

Technical characteristics of the accelerator, neutron targets, and accessory equipment are presented. This paper is aimed at physicists who are interested in the preparation of experiments to be done on an accelerator. (4 figures) (auth)

Auxiliaries and Components

3162 (LA-5351-MS) MONITOR FOR RADIOACTIVE GAS IN THE LAMPF ACCELERATOR BEAM CHANNEL. Engelke, M. J.; Israel, H. I. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 5p. Dep. NTIS $4.00.

Beam loss in accelerator structures and target areas gives rise to radioactive gases formed by interaction of secondary particles in air. A method of monitoring the air in the LAMPF accelerator beam channel using a 51.5-liter ion chamber is described. A method for control of these radioactive gases is discussed. (auth)

3163 (LA-UR-73-1320) DESIGN AND PERFORMANCE OF THE LAMPF 1-1/4 MW KLYSTRON MODULATOR. Tallerico, P. J.; Cady, R. L.; Doss, J. D. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 14p. (CONF-730951-1). Dep. NTIS $3.00.

From 11th modulator symposium; New York, New York, USA (18 Sep 1973).

A design for a very reliable single-triode modulator for a 1¼ MW modulating-anode klystron is presented. The operating voltage is 86 kV and the variable pulse length ranges from 200 μsec to 1.2 msec. The basic modulator circuit, which uses a novel Zener diode bias circuit, and several of the individual components are described in detail. Over 140,000 high-voltage hours have been accumulated on these modulators. The principal failure mechanism is grid emission from the triode. These failures can be anticipated and repaired during a normal maintenance period. The triode is then reprocessed and reused. Tube life data and a summary of the failures modes are presented. (auth)

3164 (LA-UR-73-1568) BRIEF EVALUATION OF THE CONTROL AND RF SYSTEMS IN THE CLINTON P. ANDERSON MESON PHYSICS FACILITY. Hagerman, D. C. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 10p. (CONF-731115-1). Dep. NTIS $3.00.

From seminar on high-energy accelerator science; Tokyo and Tsukuba, Japan (5 Nov 1973).

The design and operating experience with the computer control system and the rf power systems for the LAMPF linac are outlined. (WHK)

3165 EXPERIMENTAL DETERMINATION OF BREMSSTRAHLUNG ENERGY DISTRIBUTION IN THE DIRECT BEAM OF A 2 MV VAN DE GRAAFF ACCELERATOR. Brust, R.; Richter, D. Isotopenpraxis; 9: No. 1, 10-17(Jan 1973). (In German).

The determination of the bremsstrahlung energy distribution in the direct beam of a 2 MV Van de Graaff accelerator by means of a simple scintillation-spectrometric device is reported. The pulse height distribution was reproduced in the bremsstrahlung spectra by means of a R 300 type digital computer making use of an iteration display method. The investigations were performed using tungsten as the target material for low-efficiency filtration (9 mm copper equivalent) as well as for high-efficiency filtration ("homogeneous filtration") with an excitation voltage ranging from 0.6 up to 1.75 MV. Comparison of the spectrum obtained with excitation voltage ranging to 1.75 MV and low-efficiency filtration to the results of other works showed good correspondence. (auth)

3166 USE OF AN INFRARED SCANNING THERMOMETER FOR CALORIMETRIC MEASUREMENT OF A PULSED HIGH CURRENT ELECTRON BEAM. Thornton, E.; Harris, R. R. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Phys., E (London); 6: No. 11, 1155-1157(Nov 1973).

The time-integrated flux of a pulsed high-current electron beam was measured using a total-absorption graphite calorimeter array, edge supported and of approximately 20 × 20 elements. Spatial distribution of the electron flux in the plane of the nominally 150 mm × 150 mm array was determined from the heating of the individual calorimeters. Instead of measuring the calorimeter temperatures with thermocouples and recorders, their rear face temperatures were monitored using an AWRE infrared scanning thermometer which displayed the temperature in the form of a digitally coded matrix. The number of flux data points in the calorimeter plane was increased by an order of magnitude with this technique. (auth)

3167 FORMULATION OF THE LAW GOVERNING THE VARIATION OF THE AMPLITUDE OF A HIGH-FREQUENCY ACCELERATING FIELD FOR AN ELECTRON SYNCHROTRON. Baryshev, A. I.; Karapetyan, L. O.; Kordonskii, S. V. (Inst. of Physics, Erevan). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 680-681(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 21-22(1973).

In order to formulate the law governing the variation of the amplitude of the accelerating voltage in a synchrotron, the authors used a simple function generator based on the application of a nonlinear semiconductor resistor (varistor). The circuit ensures that the stipulated law will be obtained with an accuracy at worst ±2%. (auth)

3168 ANALYZER OF THE ENERGY AND PHASE DISTRIBUTIONS OF ELECTRONS IN THE BEAM. Bogomolov, A. S.; Zakutov, E. M.; Shebolaev, I. V. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 687-690(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 27-30(1973).

The construction and operation of an analyzer that analyzes the phase and energy distributions of the current density of particles in electron beams are described. The deflecting system consists of two cylindrical cavities with a working oscillation mode E_{310}. A transverse magnetic and longitudinal electric field is simultaneously used to sweep the beam; this allows precise measurements of the energy distributions of the electrons to be performed at various phase cross sections of the beam. The analyzer is applicable to electron beams having energies ranging from 10 to 3000 keV. (auth)

3169 METER FOR MEASURING THE POSITION AND SHAPE OF A BEAM OF ACCELERATED ELECTRONS. Denyak, V. M.; Nemashkalo, A. A.; Ananichuk, V. N. (Physical Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 691-694(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 31-34(1973).

The circuit of an instrument for measuring the position and shape of a beam on an investigated target is described. The circuit is designed for operation with a beam-position pickup of the monitor or ionization type. The accuracy with which the beam position is measured is at worst ±0.5 mm in the range 10^{-6} to 10^{-9} A. (auth)

3170 NONLINEAR PHOSPHORS FOR POSITIONING THE BEAM OF AN ELECTRON ACCELERATOR. Mitrofanova, N. V.; Ponomarev, V. N.; Timofeev, Yu. P.; Fridman, S. A.; Shchaenko, V. V. (Inst. of Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 695-696(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 34-36(1973).

Screens with ZnS·CdS–Ag, Ni luminophors have been developed for which the luminescence brightness is proportional to approximately the third power of the ionization density. The screens allow a contrast image of the beam to be obtained and are used for visual and photographic recording of the beam cross section in a television installation. (auth)

3171 MILLISECOND MODULATOR HAVING A POWER OUTPUT OF 30 MW. Egorov, A. A.; Kharitonov, E. N. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 777-780(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 104-107(1973).

A modulator is described having the following parameters: a pulse voltage of 30 kV; a pulse current of 1 kA; a pulse length of 1.2 msec; a repetition frequency of 5 Hz. (auth)

Ion Sources and Injection and Extraction Systems

3172 IMPROVEMENTS FOR DEVICES CORRECTING THE EXIT TRAJECTORY OF AN ACCELERATED PARTICLE BEAM FROM A CYCLOTRON TYPE ACCELERATOR. Delphin, P. (to Thomson-CSF). French Patent 2,139,671. 28 May 1971. 7p. (In French).

A device is described for correcting the exit trajectory of a beam of particles accelerated by an isochronous cyclotron or a synchrocyclotron. It is provided with two conjugated electromagnets having pole pieces in the form of rounded sectors at their ends. These electromagnets are both excited with coils, and the currents traversing these coils are identical in magnitude but flow in opposite directions thus causing the two successive sectors to have opposite polarities. (FR)

3173 AUTOMATIC MEASUREMENT AND HANDLING OF CHARGE SPECTRA OF A SOURCE OF MULTIPLY CHARGED IONS. Lang, I.; Nefed'ev, O. K.; Tret'yakov, Yu. P.; Fefilov, B. V. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 763-767(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 92-96(1973).

A method is described for automating the process of measurement and handling of the principal parameters of the source of multiply charged ions (the distribution of the masses of charges of the ions and their relative intensity) for operation into a line with a small TRA-1001 electronic computer. The experimenter controls the measurement system by means of keyboard teletype commands and an oscilloscope block. The source is for heavy ion injection into cyclic accelerators. (auth)

3174 STABILIZATION OF THE AMPLITUDE OF HIGH-VOLTAGE PULSES. Butakov, L. D.; Kiryukhina, G. F. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 790-791(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 115-116(1973).

A system is described for the amplitude stabilization of the pulses from a generator producing high-voltage pulses for supplying the inflector plates of a system for introducing the electron beam into the chamber of the 1.3 GeV Sirius synchrotron. The generator independently produces controllable positive voltage pulses. The maximum amplitudes are 22, 28, and 36 kV. The length of the pulses is 20 μsec. The stability of the flat portion of the pulses is at worst $2 \cdot 10^{-3}$. (auth)

3175 THREE-ELECTRODE ELECTRON GUN WITH A GROUNDED ANODE AND MICROWAVE MODULATION OF THE BEAM VIA THE GRID. Bogomolov, A. S.; Zakutov, E. M. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 682-683 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 23-24(1973).

The construction of an electron gun is described which shapes bunches having a phase extent of $\Delta\varphi \approx 180°$ at a frequency of 2.85 to 2.87 GHz. A microwave signal is applied to the grid, which is at the injection potential, from a grounded source of microwave oscillations via a system of two antennas. The injection voltage is 50 to 60 kV; the emission current is up to 2 A. The construction that has been developed can be used in injection systems of linear electron accelerators and in other microwave devices. (auth)

Ion Optics and Field Calculations

3176 (CONF-730324-, pp 34-36) ELECTROSTATIC UNIPOTENTIAL LENS DESIGN FOR A keV ION SOURCE. Frame, D. 1973.

From ANS Niagara–Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

3177 PERFECT DIRECTION AND VELOCITY FOCUS AT 254°34′ IN A CYLINDRICAL ELECTROSTATIC FIELD. Dromey, R. G.; Morrison, J. D.; Peel, J. B. (La Trobe Univ., Bundoora, Australia). Rev. Sci. Instrum.; 44: No. 7, 913(Jul 1973).

It is shown that for a cylindrical electrostatic analyzer, particles entering the field on the central orbit are perfectly focused on the central orbit at an angle of 254°34′ independent of their velocity or incidence angle. An application of this result is suggested. (auth)

3178 HIGH ν/γ ELECTRON BEAM IN A TORUS. Rostoker, N. (Univ. of California, Irvine). Particle Accel.; 5: No. 2, 93-97(1973).

The ratio ν/γ is approximately the ratio of field energy to particle energy. In a longitudinal magnetic field, equilibria with good stability properties exist when $\nu > \gamma$ for a beam with no neutralization. However, such equilibria are not observed when a beam is launched from a diode into vacuum because this only provides the particle energy and not the field energy. If low ν/γ beams are launched at the periphery of a torus into a rising toroidal magnetic field the beams move inward with the magnetic field. In addition, a transformer is necessary to produce a toroidal electric field. The electric field energy of the beam is provided by the coil that develops the toroidal magnetic field. The magnetic field energy is provided by the transformer. Thus a high ν/γ beam could be produced in a torus that is completely unneutralized. One application of this beam would be acceleration of heavy ions as in the HI PAC device. The advantage is that a potential well could be developed that is deeper by a factor of γ^2 than in a conventional HI PAC. Another application would be to provide very strong focusing for an ion accelerator as proposed by Budker. (auth)

Storage Rings

3179 (BNL-18306) INTERACTION OF A COASTING BEAM AND A BUNCHED BEAM WITH FREQUENCY SLIP. Month, M.; Ruggiero, A. G. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 21p. Dep. NTIS $3.25.

Collisions between a coasting beam and a bunched beam can be so arranged that a particle in the coasting beam collides with the bunched beam only intermittently. A particle thus interacts with a bunch for a given number of revolutions, say q, and then slips away into the interbunch space. The process, with each cycle taking say, n revolutions, then continues. The possible effects of this intermittent type force are considered. The linear stopbands introduced are dealt with in detail. Growth rates are obtained as a function of q, assuming a Gaussian fall-off in the force. The stabilizing influence of an azimuthally constant octupole field component is demonstrated. Isolated nonlinear resonances excited by the intermittent force are discussed. No quantitative treatment is given as far as concerns the stochastic nature of highly nonlinear systems. Also, the influence of feeding mechanisms, such as a time variation of the tune is neglected. If the number of revolutions between kicks, $\sim n$, is large, then there is the possibility of loss of correlation between kicks. The resulting diffusion is analyzed and diffusion rates are estimated. It was concluded that: (1) growth due to linear instabilities are effectively damped by making q large enough. The perturbation is turned on and off adiabatically and leaves no record of itself from cycle to cycle. The growth rate is linear in $\Delta\nu$, the beam–beam linear tune shift per interaction and per revolution; (2) the diffusion induced by random processes causing the kicks to be uncorrelated produces a beam growth rate which is quadratic in $\Delta\nu$. Although it is smaller than the gradient stopband growth (for low q), it is essentially independent of tune (and so occurs for all particles) and it has no drop-off with q. In fact, for large q, it increases like q^2; and (3), an azimuthally constant octupole field component is an effective stabilizing influence against resonant growth. (auth)

3180 (LNF-73/10) COMPUTER CONTROL SYSTEM USING THE HP BASIC LANGUAGE FOR THE STORAGE RING ADONE. Matera, M.; Tazzari, S.; Vignola, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 29 Mar 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

The Adone storage ring control room has been implemented with a computer facility. The system has been in operation for over one year. A short description of the control system hardware is given and some aspects of the software organization are discussed. (auth)

3181 (NP-19846) STUDY OF PHOTON–PHOTON INTERACTIONS BY THE e^+e^- FRASCATI STORAGE RING. Internal Note 471. Barbiellini, G.; Ceradini, F.; d'Angelo, S.; Grilli, M.; Orito, S.; Paoluzi, L.; Santonico, R.; Tsuru, T.; Valente, V.; Visentin, R. (Rome Univ. (Italy). Istituto di Fisica; Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 29 May 1973. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

Collisions between two quasi real photons were studied in the processes $e^+e^- \rightarrow e^+e^-e^+e^-$ and $e^+e^- \rightarrow e^+e^-\mu^+\mu^-$, by tagging the forward-going e^+ and/or e^-, beam energies around 2 × 800 MeV. For both processes the event rate agrees, within the statistical accuracy of 30%, with the predictions of an equivalent photon calculation. In addition, it is shown that the contamination from all photon–photon processes to the previously published annihilation cross sections is 3 ± 3% for $e^+e^- \rightarrow$ multihadrons and less than 6% for $e^+e^- \rightarrow \pi^+\pi^-$ or K^+K^-. (auth)

3182 INVESTIGATION BY TECHNIQUES OF ELECTRON STIMULATED DESORPTION OF THE MERITS OF GLOW DISCHARGE CLEANING OF THE SURFACES OF VACUUM CHAMBERS AT THE CERN INTERSECTING STORAGE RINGS. Jones, A. W. (European Organization for Nuclear Research, Geneva); Jones, E.; Williams, E. M. Vacuum; 23: No. 7, 227-230(Jul 1973).

To provide surface cleaning of the CERN intersecting storage rings, in which the pressure is below 10^{-10} torr over a 2 km length of mostly elliptical pipe (160 × 52 mm), ion bombardment during a glow discharge has been utilized. The discharge in argon at a pressure of about 3×10^{-2} torr was carried out intermittently in the course of a 15 h bake-out at 300°C. Subsequent electron scrubbing enabled the electron desorption efficiency of the surface of the ISR vacuum chambers to be reduced by two to three orders of magnitude. Information is given on the apparatus used and the procedure adopted, together with a discussion of the diagnostic technique and a consideration of the action of the discharge cleaning. (auth)

Experimental Facilities

Refer also to abstracts 3161, 3711, and 3797.

3183 (ANU-P-566) REPORT ON COMMITTEE ON DATA ACQUISITION FACILITIES FOR THE 14UD ACCELERATOR. Part 2. ADCs and Interfaces. Hay, H. J.; Bell, R. A. I.; Klein, R. E. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Feb 1973. 35p. Dep. NTIS (U. S. Sales Only) $3.75.

Summaries are given of the considerations and recommendations as to the choice of nuclear ADCs, and the requirements and functions of the interfaces between the ADCs and the data collection CPU. (AT)

3184 (CONF-730324-, pp 30-33) DESIGN OF A SUITABLE SHIELD FOR A 14.3 MeV NEUTRON GENERATOR. Rebeck, K. J. (State Univ. of New York, Buffalo). 1973.

For ANS Niagara–Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

3185 NEUTRON GENERATOR TUBE. Boutry, A.; Eschard, G. (to Commissariat a l'Energie Atomique). French Patent 2,137,248. 17 May 1971. 5p. (In French).

A neutron generator tube is presented which delivers either a continuous flux or fast neutron pulses. It consists of a gas-filled enclosure, an ionization chamber, an acceleration gap, and a target. A special feature is that the ionization chamber possesses a hot cathode and a control grid. (FR)

3186 ENERGY ANALYSERS FOR CHARGED PARTICLE BEAMS. Steckelmacher, W. (Edwards High Vacuum Ltd., Crawley, Eng.). J. Phys., E (London); 6: No. 11, 1061-1071 (Nov 1973).

A review is presented which mainly covers the retarding field and electrostatic deflection energy analyser types since these are the most suitable for use with both ions and electrons. Deflection analysers are considered for various field configurations; the main lines of development are discussed, including a guide to the numerous recent publications dealing with their design and performance. (auth)

3187 PULSED ELECTROSTATIC ACCELERATOR FOR NEUTRON STUDIES. Vorotnikov, P. E.; Vukolov, V. A.; Koltypin, E. A.; Molchanov, Yu. D.; Otroshchenko, G. A.; Yan'kov, G. B.

(Inst. of Atomic Energy, Moscow). pp 261-266 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From All-Union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The value of using an electrostatic accelerator with a pulsed beam to solve different problems in neutron and fission physics is discussed on the basis of α measurements and experiments with neutron scattering and fission isomer production. The experiments were made in the neutron energy interval from a few keV up to 1.5 MeV. A bunching system of klystron type provided the pulsed beam with about 3 ns pulse duration using a low power radio-frequency ion source. With the repetition rate of 4 MHz the mean proton current was about 5 μA. (4 figures) (auth)

3188 POLARIZATION OF A COHERENT BREMSSTRAHLUNG BEAM FROM THE SIRIUS ELECTRON SYNCHROTRON. Kalinin, B. N.; Kuznetsov, V. M.; Potylitsyn, A. P.; Sertakov, Yu. I.; Stukov, O. I.; Filipenko, N. M. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 684-686(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 24-27(1973).

A linearly polarized γ-beam was obtained from a diamond target on the "Sirius" electron synchrotron (Tomsk). The synchrotron is being used in an experiment on measurement of the asymmetry of the photoproduction of π-mesons. The orientation of the crystals was chosen in such a way that the required accuracy was obtained in a minimal measurement time. The actual values of the polarization were calculated from the experimentally measured spectrum of the coherent bremsstrahlung. (auth)

3189 ORIENTATION OF A SINGLE-CRYSTAL TARGET IN THE PATH OF A BEAM OF RELATIVISTIC POSITRONS. Morokhovskii, V. L.; Kasilov, V. I.; Kovalenko, G. D.; Fisun, A. N. (Physical-Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 697-699(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 36-38(1973).

Methods are proposed for orienting a single-crystal target in the path of a beam of relativistic positrons in accordance with a channeling effect. In a number of cases these methods offer advantages over known methods based on the coherent bremsstrahlung effect. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

3190 (NP-19867) REPORT OF THE COUNCIL FOR THE YEAR 1972–1973. (Science Research Council, London (UK)). 1973. 96p. Dep. NTIS (U. S. Sales Only) $7.00. UK 73 pence.

A section deals with the membership, policy, activities and plans of the Science Research Council. Reports on scientific research supported by the Council are under separate headings: astronomy, space and radio; engineering; nuclear physics (including high energy physics and nuclear structure physics); science, other than that covered by specific headings (including neutron beam research and Atlas Computer Laboratory); materials science and technology (including superconductors). (UK)

3191 PROCEEDINGS OF THE XXth INTERNATIONAL ASTRONAUTICAL CONGRESS (SELECTED PAPERS), MAR DEL PLATA, ARGENTINA, OCTOBER 5–10, 1969. Lunc, M. (ed.). Elmsford, NY; Pergamon Press, Inc. (1972). 996p. (In Several Languages). (CONF-691075-). $52.50.

"Extensions of Apollo", by G. E. Mueller was the title of the invited lecture at the XXth International Astronautical Congress. Fifty-eight selected papers are included in the volume. Systems design, scientific and application satellites, propulsion systems, and re-entry problems are discussed in papers presented related to spacecraft engineering. Flight trajectories, motion around the center of gravity, and optimization papers are presented that are related to astrodynamics. Trajectory control and attitude control papers are given related to astrionics. Six papers are presented that deal with bioastronautics. Four papers are presented that deal with education via satellites, and four papers related to safety in youth rocket experimentation are included. (MCW)

Cosmic Radiation

Refer also to abstracts 3392 and 3409.

3192 12TH INTERNATIONAL CONFERENCE ON COSMIC RAYS, HOBART, AUSTRALIA, AUGUST 16–25, 1971. Hobart, Australia; International Union of Pure and Applied Physics (1971). 371p. (CONF-710807–(Vol. 7)).

Separate abstracts were prepared for the sixty-one papers presented. (WDM)

For abstracts of individual papers see: 3193–3244, 3262, 3263, and 3268–3274.

3193 ENERGY SPECTRUM OF GAMMA RAYS FROM THE NUCLEAR BULGE OF THE GALAXY. Anand, K. C.; Stephens, S. A. (Tata Inst. of Fundamental Research, Bombay). pp 2542-2549 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The estimates made so far on the nature of γ rays towards the Galactic center are based only on the radiation from the disk. However, it has been observed by high-resolution telescopes at $\nu \gtrsim 1$ GHz that in the central region of the Galaxy, there is a bulge, about 2° × 1° in size superimposed by sources, with an intensity larger than that of the total background radiation in that direction. Hence the gamma ray spectrum from this bulge was evaluated after deducing the physical conditions existing in this region of space. This spectrum was compared with the background emission from the disk and with the observations. (auth)

3194 OBSERVATIONS OF HIGH ENERGY ELECTRON COMPONENT IN THE COSMIC RAYS. Matsuo, M. (Tokyo Univ.); Mikumo, E.; Nishimura, J.; Niu, K.; Taira, T. pp 2550-2555 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Data reported at the Budapest conference were checked and combined with data obtained from chambers exposed in 1969 and 1970 (800 m^{2}s and 3400 m^{2}s, respectively). Special attention was paid to scanning efficiency and method of energy determination. The spectrum of high-energy primary electrons beyond 100 GeV and the existence of a knee near 50 GeV are considered to be reconfirmed. (MRM)

3195 ENERGY SPECTRUM OF COSMIC RAY ELECTRONS AT ENERGIES ≥100 GeV. Anand, K. C.; Daniel, R. R.; Stephens, S. A. (Ioffe Inst. of Physics and Tech., Leningrad). pp 2556-2558 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

An experiment was carried out to determine the energy spectrum of cosmic-ray electrons beyond 100 GeV by using a large lead-emulsion sandwich stack in which electrons are unambiguously identified in a pure block of emulsions at the top of the stack. Preliminary results based on 22 electrons beyond 200 GeV were reported earlier. Results from further work, obtained from 51 electrons of energies ≥150 GeV, confirm the earlier findings of a possible steepening in the energy spectrum of electrons in the region between 100 to 200 GeV. (auth)

3196 PARTICLE ASTRONOMY WITH A SUPERCONDUCTING MAGNET. Buffington, A. (Univ. of California, Berkeley). pp 2559-2564 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The magnetic spectrometer technique provides a direct means of measuring the rigidity of charged primary cosmic rays to ~100 GV/c rigidity. The measured momentum values do not depend on complicated calculations or calibrations. Cosmic-ray experiments which have utilized this technique are reviewed and the prospects for its future applications are presented, emphasizing separate measurement of electron and positron spectra (with a description of a proposal for the "HEAO" satellite), and isotopic separation (in particular, measurement of ^{10}Be). (auth)

3197 COSMIC RAY DEUTERONS AND ^{3}He, INTERPLANETARY DECELERATION AND ENERGY SPECTRA OF SOURCES. Meyer, J. P. (CEN de Saclay, Gif-sur-Yvette, France). pp 2565-2575 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Cosmic-ray deuteron and ^{3}He formation mechanisms in interstellar space are recalled and interstellar d/^{4}He and ^{3}He/^{4}He ratios are predicted for several protons and ^{4}He source spectra $\phi(E) \propto (E_0 + E)^{-2.6}$, with $0 \leq E_0 \leq 938$ MeV/N. The existing observations of the d/^{4}He and ^{3}He/^{4}He ratios are then discussed in the light of the adiabatic deceleration of cosmic-ray particles in the solar cavity. It is concluded that the observations of the Chicago Group on IMP IV and IMP V, felt to be the most reliable, (i) imply source spectra close to a power law in total energy ($E_0 \geq 500$ MeV/N) for energies above ≈100 MeV/N, and (ii) are qualitatively consistent with an increase of the interplanetary energy loss between 1967 and 1969. These conclusions depend little upon the geometry of the sources and the cosmic-ray propagation modes in the Galaxy. (auth)

3198 FORMATION OF Li, Be, B, BY GALACTIC COSMIC RAYS IN SPACE, AND ITS RELATION WITH STELLAR OBSERVATIONS. Meneguzzi, M.; Audouze, J.; Reeves, H. (SEP de Saclay, Gif-sur-Yvette, France). pp 2576-2582 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The L–element (Li, Be, B) contamination rate of the interstellar gas by nuclear reactions induced by the galactic cosmic rays is calculated using a diffusion model of fast moving particles in the Galaxy. The presence of helium in the primary flux and in the interstellar gas is taken into account. It is found that most of the stellar and meteoritic data are in agreement with a model which otherwise gives a reasonable account of the observations. This model assumes an injection spectrum in total energy power ($W^{-2.6}$) diffusing in a leaking galaxy with an escape range of 6.3 g cm^{-2}. The intensity, the composition at the source, and the spectral shape have remained the same for the last 10^{10} y. However a large part of the ^{7}Li must come from another source. Two possibilities are discussed: thermonuclear ^{7}Li ejected from giant stars in "dirty" regions of the Galaxy; and spallative Li generated from an intense low energy component of the galactic cosmic radiation. (auth)

3199 STUDY ON THE CHARGE AND ISOTOPE COMPOSITION OF MEDIUM COSMIC RAY PARTICLES. Beaujean, R.; Enge, W. (Univ., Kiel). pp 2583-2588 of Twelfth International Conference on

Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

This study is based on medium cosmic-ray particles of about 106 MeV/N which come to rest in the eight 250 μ thick cellulose nitrate sheets of a 1.6 m^2 plastic detector stack. The stack was flown in July 1968 from Ft. Churchill for 10 h under 1.8 g/cm^2. The preliminary results are reported of an analysis of 0.2 m^2 of this stack. 31 B, 190 C, 83 N, and 263 O stopping particles were analyzed. Assuming all oxygen is ^{16}O the mean of the individual charge distributions corresponds to the following mass numbers: $B = 10.88 \pm 0.16$, $C = 12.22 \pm 0.08$, $N = 14.62 \pm 0.13$. On tracks where more than one pit was available the mass resolution was calculated. An average standard deviation of about 0.7 mass units was obtained. (auth)

3200 CHARGE COMPOSITION OF LOW ENERGY COSMIC RAY NUCLEI OF ELEMENTS NEON TO NICKEL. Enge, W. (Univ., Kiel); Bartholomae, K. P.; Fukui, K. pp 2589-2594 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Results of a balloon flight experiment flown from Fort Churchill, Canada, at 1.8 g/cm^2 for about 10 h in 1968, are presented. The study was made with 900 cm^2 of a 1.6 m^2 stack of 4 sheets 125 μ and 18 sheets 250 μ thick Lexan polycarbonate plastic. The results of the analysis of the charge composition, which are based upon the measurement of 325 stopping particles from neon to iron between 150 to 400 MeV/N are reported. The charge of a cosmic-ray particle was measured with an accuracy better than ±0.3 charge units, e.g., for iron. The even Z to odd Z ratio is about 2.3. A high flux of Mn for low energy cosmic rays was found. The ratios of $Mn/Fe = 0.5$, $(V + Cr + Mn)/Fe = 1.2$, $(Ca + Sc + Ti)/Fe = 1.1$ can be deduced from the measured tracks. (auth)

3201 CHARGE AND ENERGY SPECTRA OF COSMIC RAYS WITH $Z \geq 30$. Kobetich, E. J. (Univ. of California, Berkeley); Price, P. B.; Shirk, E. K.; Eandi, R. D.; Osborne, W. Z.; Pinsky, L. S.; Rushing, R. B. pp 2595-2600 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A 2g/cm^2 stack 22 m^2 in area containing 41 plastic sheets, one G-5 emulsion, and one high-speed Cherenkov film detector received an effective exposure of 48 hours at 2.8 mbar and a cutoff rigidity of ~1.8 GV. From 70 events measured in this work, together with previous results, abundance ratios relative to Fe of various charges and charge groups from $Z = 29$ to 105 were obtained. Between Fe and the Pt peak the cosmic-ray abundances appear to be similar to solar system abundances, whereas the heavier nuclei are strongly overabundant and appear to have originated less than about 10^7 y ago in a rapid neutron-capture process. The energy spectrum for $Z > 60$ appears to be steeper in shape than that of low-Z elements. (auth)

3202 AGE OF ULTRA-HIGH ENERGY COSMIC RAYS. Kocharov, G. E.; Starbunov, Yu. N. (Ioffe Inst. of Physics and Tech., Leningrad). pp 2601-2605 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The energy spectrum of ultra-high energy cosmic rays for various times of propagation were calculated taking into account the interaction with the isotropic background of photons. It is shown that the upper limit of the age of ultra-high energy cosmic rays does not exceed 10^8 y for protons and 10^7 y for heavy nuclei. This indicates the relative neighborhood of the source(s) of cosmic rays. (auth)

3203 PROPAGATION OF COSMIC RAYS USING TWO COMPONENT MODEL OF THE INTERSTELLAR MEDIUM. Rengarajan, T. N.; Stephens, S. A.; Verma, R. P. (Tata Inst. of Fundamental Research, Bombay). pp 2606-2611 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

So far in the study of the propagation of cosmic rays it has been assumed that matter is uniformly distributed in the propagation medium. However, it is known that the interstellar gas is composed of dense clouds embedded in a uniform rarified medium and hence cosmic rays encounter clouds occasionally during their propagation. Assuming then that the number distribution of clouds, a cosmic-ray particle of a given path length comes across, is Poissonian in nature, the effect of this under "steady-state" propagation model is evaluated. It is found that the flux values at energies ≲ 100 MeV/N are enhanced by at least about 15% for p and He nuclei to about 40% for iron group nuclei. A case in which a significant part of the matter traversed by cosmic rays is in the source region is considered and it is found that the L/M ratio is nearly independent of the energy in agreement with the observations. (auth)

3204 COMMENTS ON A MODEL OF THE WELL ORDERED COMPONENT OF THE MAGNETIC FIELD IN THE GALACTIC DISC. Thielheim, K. O.; Kuckoff, H. J.; Steeb, W. H.; Wenner, G. (Univ., Kiel). pp 2612-2621 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

In a paper presented at the Budapest Conference (Thielheim and Langhoff, 1970) the influence of the magnetic field of the galactic disc on the transfer of very high energy cosmic ray particles was studied by numerical integration of the equation of motion of individual particles in a model of the well ordered component of the magnetic field of the galactic disc. Advances in this model are reviewed. (WDM)

3205 HELIOCENTRIC RADIAL DENSITY GRADIENT OF RELATIVISTIC COSMIC RAYS IN 1967–68. Bercovitch, M. (National Research Council of Canada, Ottawa). pp 2658-2666 of Twelfth International Conference on Cosmic Rays in 1967–68. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Data from a group of neutron monitors ranging in asymptotic latitude from −80° to +85° was used to measure the north-south anisotropy arising from the vector product of the radial density gradient and the interplanetary magnetic field, for the years 1965-68. This measurement uniquely determines the gradient only if the rigidity dependence of the gradient is known. To circumvent this problem, the frequency-power spectrum of the interplanetary magnetic field was calculated for four periods each of ~200 days duration between 1965 and 1968; these spectrums were transformed into rigidity spectrums of the cosmic-ray diffusion coefficient, K, using the results of Jokipii's theoretical analysis. The azimuthal anisotropy, inferred from the diurnal variation, and the derived values of K were then combined to predict the north–south anisotropy. The predicted values were consistent with the measured field-dependent north–south anisotropy to within 25%. The derived diffusion coefficients imply a radial gradient for 1967-68 that varies with rigidity as follows: 16%/AU at 2.5 GV; 9%/AU at 5 GV; 5%/AU at 10 GV; 2.0%/AU at 20 GV; 0.8%/AU at 40 GV. (auth)

3206 COSMIC RAY ANISOTROPY IN INTERPLANETARY SPACE. III. The Daily Variation Third Harmonics of Cosmic Radiation. Fujimoto, K.; Nagashima, K.; Fujii, Z.; Ueno, H.; Kondo, I. (Nagoya Univ., Japan). pp 2667-2674 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Characteristics of the 3rd harmonic component of the cosmic-ray daily variation was studied based on the data obtained by the multi-directional meson telescope at Mt. Norikura for the period Nov 1968–Sep 1970. Using differences between 3rd harmonic vectors obtained by different channels of the telescope, it is concluded that the observed 3rd harmonics are due to the 3rd harmonic component of cosmic-ray anisotropy in space. The rigidity dependence of the 3rd harmonic component was found to have its peak around 100 Gv almost similar to that of the 2nd harmonic component derived from the data for the same period. Differences in the peak rigidities among the present result and those reported in Part II and derived from neutron data are discussed in relation to the solar activity during the observation periods. The direction of the 3rd harmonic component in cosmic-ray anisotropy obtained from the analysis, i.e., 7, 15, 23 h L.T., is not easily interpreted in terms of the loss cone model reported in Part II. This discrepancy, however, may be interpreted in terms of the rigidity dependence of the opening angle of the loss cone and/or differences in the diffusion–scattering processes in interplanetary space for different rigidity region. (auth)

3207 STEPLIKE NATURE OF THE 11 YEAR MODULATION IN SOLAR CYCLE 19. Carmichael, H. (Atomic Energy of Canada, Ltd., Ottawa); Katzman, J. pp 2675-2681 of Twelfth

International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Steplike alterations of the longterm modulation of cosmic radiation between 1965 and 1970 found by Stoker and Carmichael from comparison of monthly means of high latitude and equatorial neutron monitors were looked for in the previous solar cycle between 1954 and 1965. Steps were not found when the Ottawa high-latitude neutron monitor was compared with the Huancayo low-latitude neutron monitor. Nevertheless when Ottawa muon monitor data, after correction by the Dorman method for atmospheric temperature, was used instead of the Huancayo neutron monitor characteristic steps appeared. Comparisons of the two Ottawa monitors respectively with the Mt. Washington and Mawson neutron monitors, with the Hobart muon monitor and with the Itabashi ion chamber tend to confirm the reality of the steps. (auth)

3208 STUDY OF COSMIC RAY PROPAGATION IN THE INTERPLANETARY MAGNETIC FIELD ON THE BASIS OF THE KINETIC EQUATION. 2. Dorman, L. I.; Kats, M. E. (Inst. of Terrestrial, Magnetism, and Radio-wave Propagation, Moscow). pp 2682-2692 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Movement of charged energetic particles in interplanetary space are considered. A kinetic equation describing the charged particle movement in interplanetary space was derived without limiting assumption on the gaussian distribution of interplanetary magnetic field inhomogeneities. In contrast to earlier works the presence of fluctuations in the solar wind velocity was taken into account. This, in turn, results in the necessity to include the correlations of random component of the velocity of solar wind and magnetic field. The equation obtained was also studied for some cases of practical interest in investigating the propagation and energy variations solar cosmic rays in the interplanetary space; the solution of this equation has been found. The expression for the function of charged particle distribution in the momentum space has been found. Comparison with observational data is made. (auth)

3209 STUDY OF HIGH ENERGY ELECTRONS AT UPPER LAYERS OF ATMOSPHERE DURING MAGNETIC PERTURBATIONS. Galper, A. M.; Dmitrenko, V. V.; Kirillov-Ugryumov, V. C.; Luchkov, B. I.; Nikolsev, Yu. A.; Shermanzon, B. M. (Inst. of Physical Engineering, Moscow). pp 2693-2697 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Cosmic-ray electrons between 100 and 1500 MeV were measured at the upper layers of the atmosphere with the help of a balloon-born detector at the geomagnetic latitudes 46°, 49° and 58°N. The effects of the increase of the electron flux were observed during magnetic substorms. (auth)

3210 PARTIAL BAROMETRIC COEFFICIENTS OF THE INTENSITY OF COSMIC RAY NEUTRON COMPONENT BY THE DATA OF WORLD NETWORK OF STATIONS. Dorman, L. I. (Inst. of Terrestrial, Magnetism, and Radio-wave Propagation, Moscow); Shatashvili, L. Kh.; Rogava, O. C. pp 2698-2705 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

3211 TIFR AIR SHOWER EXPERIMENTS. Sreekantan, B. V. (Tata Inst. of Fundamental Research, Bombay). pp 2706-2719 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Experimental results on high-energy hadronic and muonic components of EAS obtained from the Ooty and KGF air shower arrays are summarized. In the Ooty array, which is designed for the study of showers in the size range 10^4 to 10^7 particles at 2.2 km altitude, a large area total absorption spectrometer and a large area (2 m × 1.5 m × 1 m) multiplate cloud chamber (with 21 iron plates each 2 cm thick inside) were used as the hadronic detectors. Results are presented on the time structure of hadrons, the energy spectrum, variation of the number of hadrons with size, the charged to neutral ratio of hadrons, the properties of showers associated with multiple incidence of hadrons of energy > 100 GeV and the frequency of muon bundles. In the KGF air shower array muon detectors at three underground depths corresponding to 220, 640, and 1200 GeV are in operation and results are presented on the energy spectrum of muons of energy > 200 GeV and the variation of their number with size. Preliminary results on the properties of showers associated with muons of energy > 1200 GeV are presented. Extensive Monte Carlo calculations were made on various shower parameters on the basis of different models of high-energy interactions and the primary charge composition in the relevant energy range of 10^{14} to 10^{17} eV. Conclusions that can be drawn from a comparison of the experimental results on muons and hadrons from the two arrays with the theoretical predictions are discussed. (auth)

3212 CHACALTAYA LARGE AIR SHOWER EXPERIMENT. Keneko, T. (Universidad Mayor de San Andres, LaPaz, Bolivia); Yokoyama, C.; Nishi, K.; Mejia, G.; Trepp, A.; Pacheco, J.; Aguirre, C.; Murakami, K.; Kamata, K.; Suga, K.; Toyoda, Y. pp 2720-2723 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A new air shower experiment at Mt. Chacaltaya (5,200 m a.s.l.) is being set up and is expected to come into operation in the latter half of 1971. The brief description of the air shower array is presented. A comparison of the longitudinal development curves of air showers with energies 10^{15} to 10^{17} eV obtained from the zenith angle distributions of the Bolivian Air Shower Joint Experiment with the theoretical predictions suggests more enhanced meson multiplicity than that proportional to $E_0^{1/4}$, and this suggestion is one of the motivations of this experiment. (auth)

3213 HIGH ENERGY HADRONS OF EXTENSIVE AIR SHOWERS. Matano, T. (Saitama Univ., Urawa, Japan); Machida, M.; Ohta, K.; Ishizuka, T.; Tanahashi, G. pp 2724-2729 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Twenty four emulsion chambers each of area 0.25 m^2 combined with scintillation detectors of the same area were used to study high-energy hadrons in air shower cores. Energy spectra and lateral distributions of hadrons with energy between 1 and 10 TeV were obtained from the data of bursts observed by the scintillation detectors and compared with the results from the emulsion chambers. To study the existence of large transverse momenta, the transverse momentum of each hadron observed in the emulsion chamber was determined. The relation between the total number of hadrons and muons in an air shower was also studied. The results were compared with simulated air showers. (auth)

3214 NEW STUDIES OF EAS AND COSMIC-RAY COMPOSITION AT ENERGIES APPROX. 3×10^{12} eV. Grindlay, J. E. (Harvard Coll. Observatory, Cambridge, MA). pp 2730-2735 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The relative muon density near ($r \lesssim 40$ m) the core at ~550 g/cm^2 and the electron number at the EAS maximum (~330 g/cm^2) for EAS with $E_0 \sim 3 \times 10^{12}$ eV have been associated with the characteristic features of the Cherenkov light distributions observed at these median depths with a high-resolution array of Cherenkov telescopes. Three-dimensional Monte Carlo calculations of proton-initiated EAS with $E_0 = 3000$ GeV have supported this interpretation. Experimental data on the ratio of muon to electric Cherenkov components in ~300 EAS are discussed and compared with the calculated variation of this ratio with primary mass A, as derived from Monte Carlo calculations of He- and C-initiated EAS in addition to the proton primary results. The results suggest a composition at $E_0 \gtrsim 3 \times 10^{12}$ eV, in approximate agreement with the low-energy ($\lesssim 10^{11}$ eV) composition except for a possible suggestion of an overabundance of very heavy ($A \gtrsim 30$) cosmic-ray primaries. (auth)

3215 STUDY OF AIR SHOWERS OF ENERGIES ABOVE 10^{18}eV. Kawaguchi, S.; Sakuyama, H.; Suga, K.; Takano, M.; Uchino, K.; Hara, T.; Ishikawa, F.; Nagano, M.; Tanahashi, G. (Tokyo Univ.). pp 2736-2741 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The observation of air showers of energies above 10^{18}eV by the INS large air shower array has been continued. Ratio of density of all particles measured with scintillation detectors to that measured with the spark chamber at a large distance was obtained. The average amount of muons above 5 GeV and the fluctuation are presented. And the implication of the fluctuation is considered. The density spectra reported at the Budapest Conference are refined and the energy spectrum of primary cosmic rays is discussed. An extremely large air shower produced by a primary cosmic ray with energy 4×10^{21}eV is also described. (auth)

3216 EVIDENCE FOR A PRIMARY COSMIC RAY PARTICLE WITH ENERGY 4×10^{21} eV. Suga, K.; Sakuyama, H.; Kawaguchi, S.; Hara, T. (Tokyo Univ.). pp 2742-2747 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The analysis of an extremely energetic air shower produced by a primary cosmic-ray particle of energy 4×10^{21}eV is described. The arrival direction of this cosmic ray is R.A.20hr14.5min and declination 24°. The directions of quasar 3C 409 and pulsar AP 2015+28 are inside the uncertainty of the arrival direction. Information on muons and the total number of charged particles in this air shower indicates no drastic change of the character of nuclear interactions from 10^{17}~10^{18}eV to 10^{22}eV. (auth)

3217 LATERAL STRUCTURE OF LARGE EAS. Miyake, S.; Ito, N.; Kawakami, S.; Hayashida, N.; Suzuki, N. (Osaka City Univ.). pp 2748-2752 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The lateral structure of the electron component of EAS was studied in detail using one hundred plastic scintillators arranged in a lattice configuration. The average age parameter of lateral structure was found to be slowly decreasing with shower size up to about 10^7 in size of EAS but it turns to increase at higher than about 10^8. This fact affects the estimation of size at larger size. And it will be necessary to interpret the experimental result in terms of nuclear interaction character in the very high-energy region. (auth)

3218 RADIO WAVE EMISSION FROM EXTENSIVE AIR SHOWERS. Fujii, M.; Nishimura, J. (Tokyo Univ.). pp 2753-2758 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Further extensions of Kahn–Lerche theory are made, in which the altitude variation, the lateral distribution of the current, and the shape of the shower front are included. These quantities are calculated using the three dimensional cascade theory. Analytical solutions of the lateral distribution of the radio intensity are derived from the extended Kahn–Lerche theory. The characteristics of this distribution are discussed referring to the emissivity of radio waves and the interference effect of radio waves. (AT)

3219 NUCLEAR INTERACTIONS OF PROTONS OF ENERGIES 10^{12}–10^{14} eV (CHACALTAYA BURST EXPERIMENT). Kaneko, T. (Universidad Mayor de San Andres, La Paz, Bolivia); Yokoyama, C.; Aguirre, C.; Trepp, A.; Mejia, G. R.; Pacheco, J.; Murakami, K.; Kamata, K.; Toyoda, Y.; Maeda, T.; Suga, K.; Uchino, K.; LaPointe, M.; MacKeown, P. K. pp 2759-2768 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

High-energy nuclear bursts with energy greater than 3×10^{12} eV have been observed at Chacaltaya, Bolivia (5200 m.a.s.l.). These are most likely to be produced by surviving primary protons arriving at Chacaltaya without interaction in the atmosphere. The experimental results show that the energy spectrum of these surviving primaries is represented by a power law with an exponent −2.3 for the energy range 3×10^{12} to 5×10^{13} eV. This spectrum is steeper than the total primary spectrum with an exponent of −1.7. The result can be explained in three alternative ways: (1) The primary proton spectrum becomes steeper, while primaries become more abundant in heavy nuclei above a few times 10^{12} eV. (2) The inelastic cross section for proton–air nucleus collision increases with increasing energy. (3) There exist frequent quasi-elastic collisions with very small inelasticities. These three possibilities are studied using data accumulated for the last three years. From the experimental results it is possible to conclude that in the third case, the spectrum becomes flatter only in the case of very extreme assumptions on the elasticity distribution, and the first and second cases are possible. (auth)

3220 FLUX OF PIONS AT THE ENERGY OF 100 TO 400 GeV AND THEIR INTERACTION IN IONIZATION CALORIMETER. Denisova, V. G.; Eriskovskii, A. P.; Fetisov, I. N.; Guseva, V. V.; Kim, V. M.; Kotelnikov, K. A.; Lebedev, A. M.; Maximenko, V. M.; Puchkov, V. S.; Slavatinskii, S. A.; Zelevinskaya, N. G. pp 2769-2774 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Single pions and protons in the region 100 to 400 GeV were identified by cloud chamber ionization at Tien-Shan. Energies were determined with an ionization calorimeter. Pion-proton ratios were determined. Distribution of the first moments of cascades for charged and neutral primaries are given. (AT)

3221 CHACALTAYA EMULSION CHAMBER EXPERIMENT. III. Large Air Shower Event Andromeda. Japan-Brasil Collaboration. pp 2775-2780 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The large event was observed in the emulsion chamber (48 m^2) and thickness 11 cm Pb exposed on Mt. Chacaltaya (540 g/cm^2) during May 1968–April 1969. It is considered as the early stage of an EAS. The event is visually composed of the following three parts: 1. Black nucleus at the center; diameter of 3 cm which turns completely black on x-ray films; estimation of the total radiated energy is obtained as 1.6×10^{16} eV by photometric measurement on the opacity of the x-ray films; 2. Very high energy γ rays in the black nucleus; with microscope existence of 30 γ rays (or electrons) with energy ranging 5 to 50 TeV is recognized in the nucleus. The integral energy spectrum is proportional to $E^{-\gamma}$ with $\gamma = 1.0$; 3. Associated particles of the electromagnetic and the nuclear active components in the outer region; in the outer region of radius $r \gtrsim 2$ cm, are observed about 240 particles of electromagnetic component and 16 events of Pb-jets, with their energy spectra $E^{-\gamma}$, $\gamma = 1.6 + 0.5$. Lateral distribution of both components can be represented as $\exp(-r/r_o)rdr$ with $r_o = 5 + 0.5$ cm. (AT)

3222 CHACALTAYA EMULSION CHAMBER EXPERIMENT. II. Atmospheric Interactions. Japan-Brasil Collaboration. pp 2781-2785 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Out of γ-ray families observed by chamber no. 14 and others, 41 events are selected by the criterion that they are the atmospheric nuclear interactions produced near the chamber, within 1000 m above the chamber. The events cover the energy region of $\Sigma E_\gamma =$ 10 to 150 TeV. Out of them, 28 events are the nuclear interaction with the same property as the local nuclear interactions, showing emission of a fireball with γ-ray mass 1.4 ± 0.5 GeV (total rest mass 2.2 ~ 2.6 GeV). The rest, 13 events show emission of a fireball with much larger mass, its γ-ray mass being about 8.0 ± 2.0 GeV (total rest mass will be 20 ~ 30 GeV). This new type of fireball is named as super heavy (SH) quantum. From the angular and energy distribution of γ-rays, the decay scheme of the SH-quantum was considered as of the two step through H-quanta. The evidence for existence of the SH-quantum found in other experiments (including the Bristol–Bombay balloon experiment) is discussed. (AT)

3223 CHACALTAYA EMULSION CHAMBER EXPERIMENT. I. Nuclear Interactions in Emulsion Chamber. Japan-Brasil Collaboration. pp 2786-2791 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Fireball analysis was made on 90 events of local nuclear interactions of chambers no. 12 and 13, and on some more events of a new chamber no. 15. The experiment covers range of the gamma-ray interaction energy $\Sigma E_\gamma = 3$ to 30 TeV, and the observation gives angular and energy distribution of the produced gamma rays from the interaction. The fireball analysis shows consistency of the experimental data with the hypothesis of isotropic fireball emission of a constant mass and temperature (the H-quantum proposed by Hasegawa). A comparison was made between the data with those from the Japanese balloon experiment, and Bristol–Bombay collaboration balloon experiment and others, applying the same method of fireball analysis. All of them are in agreement within the experimental error. The comparison is made with the results of simulation calculation under the hypothesis of a fireball production. The best fit can be obtained with value of the rest energy as 2.2 to 2.6 GeV under the assumption of symmetry in the charge states. (AT)

3224 OBSERVATION OF HIGH ENERGY INTERACTIONS AT AEROPLANE ALTITUDE. Niu, K. (Tokyo Univ.); Mikumo, E.; Maeda, Y. pp 2792-2798 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

An analysis is presented on a nuclear interaction observed by emulsion chambers with producing layers exposed at an aeroplane altitude. Among secondary particles produced in a high energy jet shower, a possible decay in flight of a particle of unknown type was found. (auth)

3225 ATMOSPHERIC GAMMA RAYS OF ENERGY GREATER THAN 50 GeV. Anand, K. C.; Daniel, R. R.; Stephens, S. A. (Tata Inst. of Fundamental Research, Bombay). pp 2799-2803 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A large stack of lead-emulsion sandwich detectors was flown over Hyderabad, India, under 10 g cm^{-2} of atmospheric depth. The emulsions were scanned for cascades, and γ rays were unambiguously identified and their energies determined. From an analysis of 103 gamma rays of energy $\gtrsim$90 GeV it was found that the differential energy spectrum is a simple power law with a spectral index of about −2.6, consistent with that of the primary nucleonic component. This spectrum seems to join smoothly with the spectrum at low energies above 40 GeV, measured previously at the same latitude under the same atmospheric depth but deviates from the spectrum below 40 GeV. The production spectrum of gamma rays at energies above 50 GeV indicates that its source of origin may be different from that at low energies. The atmospheric electron spectrum is also derived from the gamma-ray spectrum. (auth)

3226 CRITICAL REMARKS ON THE THEORY OF ELECTROMAGNETIC CASCADE LONGITUDINAL DEVELOPMENT. Thielheim, K. O.; Zoellner, R. (Univ., Kiel). pp 2804-2812 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A method for the numerical integration of the system of cascade equations describing the longitudinal development of electromagnetic cascades has been proposed recently (Thielheim and Zoellner, 1970). In the aforementioned paper results were compared of numerical integrations obtained on the basis of cross sections represented in the appendix to this paper with results obtained by other authors through Monte Carlo simulations in a region where such data were available. (WDM)

3227 COSMIC RAY FLUX AND STOPPING MUONS UNDERGROUND. Cottrell, D. M. (San Diego State Coll., CA); Piserchio, R. J.; Anderson, S.; Lord, J. J. pp 2813-2818 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Underground emulsion stacks were used to measure the intensity of nuclear interactions and stopping particles. At depths under 1000 hg./cm^2, each muon nuclear interaction leads to the production of about four pions as a consequence of the associated hadronic cascade. The cascades also contribute significantly to the interpretation of the observed intensities of stopping muons. (auth)

3228 RATE OF MUONS STOPPING UNDERGROUND. Barton, J. C. (Polytechnic, London). pp 2825-2828 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

In a recent publication Baschiera et al. (1970, Lettere al Nuovo Cimento, 4, 121-3) reported that, at depths greater than 100 hg cm^{-2}, the experimentally measured ratio of the stopping muon rate to the traversing muon rate was much higher than that predicted theoretically. Data obtained from the measured rates of stopping muons and pions in the Holborn underground laboratory are used to show that these authors have under-estimated the effects of nuclear interactions. It is also shown that their theoretical predictions need to be modified by a more exact treatment. The overall effect is to reduce greatly any discrepancy, although it is not yet clear whether theory and experiment are in completely satisfactory agreement. (auth)

3229 UNSTABLE PARTICLES UNDERGROUND. Bhat, P. N.; Murthy, P. V. R. (Tata Inst. of Fundamental Research, Bombay). pp 2829-2835 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A systematic investigation of the fluxes of particles that come to rest and decay at various depths underground has been started in the Kolar Gold Fields (KGF), India, with two aims: (i) to see if the stopping muon flux can be understood in terms of the known processes or if any new process of production is taking place, and (ii) to see if there are any particles, other than muons, with lifetimes in the range 0.1 to 50μ s. The experiment which was started in April 1971 is still in progress. Preliminary results from the observations made so far are reported. (auth)

3230 FURTHER STUDY OF HORIZONTAL AIR SHOWERS. Mikamo, S.; Yoshii, H.; Nagano, M.; Furuya, T.; Hara, T.; Kawaguchi, S.; Suga, K.; Tanahashi, G. (Tokyo Univ.). pp 2836-2841 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A further study of horizontal air showers has been made by accumulating more data with the apparatus previously used at the INS, University of Tokyo and newly installed equipments which are 6 m^2 vertical wide gap spark chambers and six 1 m^2 vertical density detectors. The newly installed apparatus was used in an attempt to study the current questions open, on particularly the size spectrum and zenith angle distribution of horizontal air showers. The result from new series of the experiment is not statistically enough to modify the whole body of the previous data, and is presented as being only preliminary. (auth)

3231 EXPERIMENTS USING THE SCINTILLATOR STACK TECHNIQUE IN THE WOODHEAD TUNNEL. Barton, J. C.; Rogers, I. W.; Wright, A. G. (Polytechnic, London). pp 2842-2847 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A stack consisting of six scintillation counters interleaved with lead has been operated in both the Holborn underground laboratory and in the Woodhead tunnel under the Pennines, at depths below the surface of 60 hg cm^{-2} and 450 hg cm^{-2} respectively. By comparing the rates of electromagnetic interactions at the two depths it has been possible to make an estimate of the contribution due to direct pair production which is relatively insensitive to systematic errors. For secondary energies in the range from 0.1 to 30 GeV the results confirm the theoretical predictions for both knock-on and pair production to within about 15% in each case. By dividing the stack into two horizontally separated three layer stacks results have also been obtained, at the greater depth, on the rate and multiplicity of muon showers. (auth)

3232 SURVEY ON THE TESTS OF ISOTROPY AND LOCALITY CONCEPTS OF SPACE AND TIME BY THE DISTRIBUTIONS OF THE COSMIC RAY MUON INTENSITY. Mizutani, K.; Mori, K. (Saitama Univ., Urawa, Japan). pp 2848-2852 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Based on Tati's exponential form factor for the weak interaction vertex represented by a unit timelike vector, the momentum of decaying particle and the parameter of nonlocality, the cosmic-ray muon intensities at various energy ranges were subjected to a survey for the special relativity breakdown. (auth)

3233 HIGH ENERGY NEUTRINO INTERACTIONS: ANALYSIS OF THE CWI NEUTRINO EXPERIMENTS. Reines, F. (Univ. of California, Irvine); Chen, H. H.; Gurr, H. S.; Kropp, W. R.; Landecker, P. B.; Lathrop, J. F.; Sandie, W. G.; Sobel, H. W.; Crouch, M. F.; Sellschop, J. P. F.; Bourne, D.; Coxell, H. pp 2853-2859 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

An interim analysis of the data from the Case–Wits–Irvine neutrino experiments is presented. The number of events associated with atmospheric neutrinos now exceeds 100. The observed rate is consistent with that expected from the interactions of such neutrinos with the rock surrounding the detectors. This rate is interpreted in terms of the behavior of the neutrino–nucleon cross section at high energies. Improved limits are set on the possible linear growth of the inverse beta cross section and on the mass of the intermediate boson of the weak interaction. (auth)

3234 EXPERIMENTAL DETERMINATION OF THE COSMIC RAY AND NEUTRINO INDUCED MUON FLUXES DEEP UNDERGROUND. Reines, F. (Univ. of California, Irvine); Chen, H. H.; Gurr, H. S.; Kropp, W. R.; Landecker, P. B.; Lathrop, J. F.; Sandie, W. G.; Sobel, H. W.; Crouch, M. F.; Sellschop, J. P. F.; Bourne, D.; Coxell, H. pp 2860-2864 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The C.W.I. neutrino detector in operation for about two years is fully described. Sample events, apertures, run times, as well as the observed counting rates for various types of event are given. The cosmic-ray and neutrino induced muon fluxes deep underground are resolved and magnitudes deduced. (auth)

3235 ABSOLUTE MEASUREMENT OF THE VERTICAL COSMIC RAY MUON INTENSITY NEAR 1 GeV/c AT 12°N. De, A. K.; Ghosh, P.; Mitra, S.; Bhattacharya, P. C.; Das, A. K. (Calcutta Univ.). pp 2870-2874 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The integral cosmic-ray muon intensity in the vertical direction at sea level at 12°N (Calcutta) was measured with a range-spectrometer similar to that of Allkofer, et al. (1970) at the momentum of 0.954 GeV/c ± 0.5% and found to be 6.86×10^{-3} cm^{-2} str^{-1} sec^{-1}. This value is 10.8% lower than that obtained by Allkofer, et al. and 14.3% higher than that of Rossi intensity (1948) at places of latitude 55°N. The results are in favor of the experimental results of Allkofer, et al. The decrease in intensity may be explained in terms of geomagnetic latitude effect. (auth)

3236 PROCESSES RESPONSIBLE FOR THE PRODUCTION OF HIGH ENERGY MUONS. Krishnaswamy, M. R. (Tata Inst. of Fundamental Research, Bombay); Menon, M. G. K.; Narasimham, V. S.; Hinotani, K.; Kawakami, S.; Miyake, S. pp 2875-2880 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The angular distributions of muons have been measured in the Kolar Gold Mines at depths of 754, 1500, and 3375 hg/cm^2 (Kolar). These distributions are consistent with the normal picture that the observed muons arise through the decay of pions and kaons. There is no evidence from these observations for the X-process postulated by the Utah group in which muons are produced directly or through the decay of very short-lived parent particles. If the X-process did operate there would be much less enhancement in muon intensity at large angles than observed by us. The question arises whether the events recorded at large angles could contain a significant fraction of locally produced low-energy pions and muons capable of penetrating the relatively thin telescope. The analysis in this paper shows that the flux of such low energy particles is very small and does not reduce the observed enhancements at large angles. (auth)

3237 ANGULAR DISTRIBUTION OF MUONS AT A DEPTH OF 1500 hg/cm^2 (KOLAR) IN THE KOLAR GOLD MINES. Krishnaswamy, M. R. (Tata Inst. of Fundamental Research, Bombay); Menon, M. G. K.; Narasimham, V. S.; Hinotani, K.; Kawakami, S.; Miyake, S. pp 2881-2885 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A telescope of area 4 m^2 consisting of vertical layers of plastic scintillator, neon flash tubes, and iron absorber has been in operation at a depth of 1500 hg/cm^2 (Kolar) in the Kolar Gold Mines to study the angular distribution of muons. From the angular distribution observed it is concluded that muons with energies up to about 10 TeV are produced predominantly through the decays of pions and kaons and that there is no evidence for the existence of the "X-process" proposed by the Utah group. (auth)

3238 ANGULAR DISTRIBUTION OF MUONS AT A DEPTH OF 3375 hg/cm^2 (KOLAR) IN THE KOLAR GOLD MINES. Krishnaswamy, M. R. (Tata Inst. of Fundamental Research, Bombay); Menon, M. G. K.; Narasimham, V. S.; Hinotani, K.; Kawakami, S.; Miyake, S. pp 2886-2891 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The angular distribution of atmospheric muons observed at a depth of 3375 hg/cm^2 (Kolar) from an experiment recently completed is fully consistent with the normally assumed picture that these muons are produced predominantly through the decay of pions and kaons; there is no evidence for the "X-process" proposed by the Utah group up to a muon energy of 10 TeV. From 35 observed cases of rock showers a muon interaction cross section of 8×10^{-30} cm^2/N has been obtained. From the observed decoherence curve for parallel muons, the average transverse momentum of the parents of muons with energies around 2 TeV is estimated to be ~0.5 GeV/c. (auth)

3239 GAS PRESSURE CONTROL SYSTEM FOR A STABLE SOFT X-RAY COUNTER. Ogawara, Y.; Miyamoto, S. pp 2892-2895 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A gas control system of the rocket-borne proportional counter was developed for the x-ray astronomy observations over a very soft x-ray range. The system assured the stability of the counter sensitivity to one percent or less. (auth)

3240 COSMIC-RAY SPECTROGRAPH USING THE TIME-OF-FLIGHT COUNTER SYSTEM AND THE WIRE SPARK CHAMBER TECHNIQUE. Iida, S.; Kamiya, Y. (Nagoya Univ., Japan). pp 2896-2901 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The characteristic of a horizontal cosmic-ray spectrograph designed for the measurement of high-energy cosmic-ray muons is described. The spectrograph consists of a solid iron magnet as the deflecting element, six trays of wire spark chambers with magnetic ferrite core memory to register the particle trajectories, two layers of scintillation counters using the time-of-flight technique to trigger the wire spark chambers, and an automatic recording system. The acceptable momentum range is 8 to 5000 Gev/c; the collection power is 70 cm$^2\cdot$sr for an infinite momentum, and the counting rate above 1 TeV/c is expected to be 2/day. (auth)

3241 COMBINED CHARGED PARTICLE AND NEUTRON SCINTILLATION DETECTOR. Barton, J. C.; Pourgorides, A. M.; Rogers, I. W. (Polytechnic, London). pp 2902-2905 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A detector has been constructed which should be particularly useful for the study of neutron production by muons. It consists of a shallow "Perspex" box, containing a liquid scintillator, which is viewed by a single photomultiplier. The box is surrounded by a thin layer of a mixture of enriched lithium fluoride and zinc sulphide. With this arrangement charged particles are recorded by the liquid scintillator in the conventional manner whilst neutrons, after moderation in the liquid scintillator or additional surrounding moderator, are captured in the lithium. The resulting alpha particle is detected by the zinc sulphide, from which the light is transmitted to the photomultiplier by the liquid scintillator, acting in this case as a wavelength shifting light-guide. The relatively long decay time of the zinc sulphide makes it possible to distinguish electronically those photomultiplier output pulses due to neutrons. (auth)

3242 CALCULATIONS ON VERY FAST CHERENKOV DETECTOR TIME RESPONSE IN EXTENSIVE AIR SHOWER APPLICATIONS. de Villiers, E. J. (Univ. of Potchefstroom, S. Afr.). pp 2906-2912 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Extensive calculations were carried out to determine a suitable relation between the dimensions of a Cherenkov detector and its time resolution and efficiency for different shower densities. The properties of a Cherenkov radiator, a Philips XP1040 photomultiplier, and the responses of two discriminator types were numerically simulated. From the results it is possible to select a detector with certain dimensions according to the purpose it should serve in shower experiments. (auth)

3243 IMPROVEMENT OF THE CHARGE RESOLUTION OF LEXAN POLYCARBONATE PLASTIC DETECTORS BY ULTRAVIOLET IRRADIATION. Enge, W.; Schmitt, H. O.; Bartholomae, K. P.; Beaujean, R. (Univ., Kiel). pp 2913-2918 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The effect of ultraviolet irradiation on heavy-ion tracks in Lexan-polycarbonate was studied. Irradiations with wavelengths longer than 3000 Å keep the bulk etching rate v_b nearly constant whereas the track etching rate v_t increases strongly with increasing energy loss and with longer irradiation times. Thus the sensitivity v_t/v_b was increased by a factor of 4 to 40, i.e. the charge resolution on heavy ions can be improved by a factor of two to three applying irradiation in the order of days. (auth)

3244 PRIMARY COSMIC RAY MUON DATA RECORDING ON AN ASTRONOMICAL TIME BASE. Kisselbach, V. J. (Max Planck-Institut fuer Aeronomie, Lindau, Ger.). pp 2919-2921 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

It is pointed out that modern electronic time base generation systems make it possible to record cosmic-ray intensity directly in sidereal time intervals. A system used at Lindau/Harz, W. Germany for this purpose is described. The errors are shown to be relatively negligible for most commonly encountered coincidence devices. Although a small difference of 4 minutes per day (approximately) exists between sidereal and solar time bases, nonetheless, from the character of the phenomenon itself, a recording in proper sidereal time is advocated. The primary advantage of such data recording lies in the lack of any necessity to interpolate values acquired in solar time. For data so recorded, no subsequent interpolation adjustments are necessary. Some mention is made of classic astronomical examples of errors which arose from imprecise time bases. (AT)

3245 EXPERIMENTAL DATA ON EXTENDED AIR SHOWERS AT HEIGHTS OF 5000 TO 12,000 M. Antonov, R. A.; Ivanenko, I. P.; Tulinova, Z. I. (Moscow State Univ.). Yadern. Fiz.; 18: No. 3, 554-559(Sep 1973). (In Russian).

Height dependence of EAS with the particle numbers $>10^6$ was investigated in the height range, corresponding to the pressure range 530–197 $g \cdot cm^{-2}$, by means of a set up consisting of 22 scintillation counters and a block of spark chambers. Comparison of the experimental data with calculations indicates that as a result of interactions of particles with energies $\sim 10^6$ GeV an essential part of the energy is transferred to a great number of low-energy π^0 mesons or γ quanta. (auth)

3246 PROJECT COLD FLARE. Gerathewohl, S. J. (Office of Aviation Medicine, Washington, DC). Rev. Med. Aeronaut. Spatiale; 12: 33-37(1973).

Description and results of a project designed to measure solar proton and galactic background radiations at SST cruising altitudes, using RB-57F aircraft flying over routes at high geomagnetic latitudes are given. A radiation measuring device called the High Altitude Radiation Instrument System (HARIS) was designed, built, and flown in these aircraft during alert/scramble missions. The HARIS included a linear energy transfer spectrometer, a tissue equivalent ionization chamber, and a Geiger–Muller tube, with data recorded on a digital magnetic tape recorder. A Concorde in-flight radiation warning device was also used in some of the flights. Solar proton radiation measurements showed maximum readings on absorbed dose rate of 1.0 mrad/hr and a dose equivalent rate of 2.0 mrem/hr. Cosmic background radiation data averaged 0.45 mrad/hr and 0.9 mrem/hr, respectively. (IAA)

3247 MEASUREMENT OF THE MOMENTUM SPECTRUM AND CHARGE RATIO OF COSMIC RAY MUONS AT 30° TO THE ZENITH IN THE RANGE 70 TO 2600 GeV/c. Higgs, B. J. New Haven; Yale Univ. (1973). 119p. University Microfilms Order No. 73-23,119.

Thesis (Ph. D.).

A large variable-inclination magnetic spectrometer was constructed to measure the spectra of cosmic ray muons at different zenith angles in the TeV energy range. Scintillation counters and optical spark chambers were used to detect the particles, and a solid iron magnet provided momentum analysis. Film generated on the spectrometer was measured on a computer-controlled automatic film reader. The resolution of the spectrometer was measured, and its maximum detectable momentum found to be in excess of 4 TeV/c. The momentum spectrum and the charge ratio of cosmic ray muons was measured at 30° zenith angle in the range 70 to 2600 GeV/c. Within the limitations of statistics, the spectrum follows a power law, and the charge ratio remains constant. (Diss. Abstr. Int., B)

Stars

Refer also to abstracts 3681 and 4078.

3248 MORE HIGH-SPEED PHOTOMETRY OF CATACLYSMIC VARIABLES. Warner, B. (Univ. of Cape Town). Sky Telesc.; 46: No. 5, 298-300; 305(Nov 1973).

Photometric observations of the eclipsing catacylsmic variables Z chamaeleontis and VW Hydri are summarized. (WDM)

3249 SPECTROPHOTOMETRIC RESULTS FROM THE COPERNICUS SATELLITE. I. Instrumentation and Performance. Rogerson, J. B.; Spitzer, L.; Drake, J. F.; Dressler, K.; Jenkins, E. B.; Morton, D. C.; York, D. G. (Princeton Univ. Observatory, NJ). Astrophys. J.; 181: No. 3, L97-L102(1 May 1973).

The Princeton telescope–spectrometer on the OAO spacecraft Copernicus scans stellar spectra with a resolution of about 0.05 Å between 950 and 1450 Å, and twice this in first order between 1650 and 3000 Å. The pointing during several minutes is steady within $0''.02$, and the measured photometric precision in the shorter wavelength range is limited only by the statistics of photon counts, with 14-s counts of about 10^3 on an unreddened B1 star, $M_v = 5.0$, at 1100 Å. In the 1650-3000 Å wavelength range, phototube noise resulting from cosmic rays makes observations difficult on stars fainter than $M_v = 3.0$. (auth)

3250 PHOTOMETRIC STUDY OF THE INTEGRATED LIGHT OF CLUSTERS IN THE MAGELLANIC CLOUDS AND THE FORNAX DWARF GALAXY. Danziger, I. J. (Harvard Coll. Observatory, Cambridge, MA). Astrophys. J.; 181: No. 3, 641-655(1 May 1973).

The results of an 11-color photometric study of 20 globular clusters and eight open clusters in the Magellanic Clouds and three globulars in Fornax are reported. Because the photometric system is designed to measure absorption-line features in late-type spectra the important results relate to the metal content of globular clusters or old evolved systems. Comparison with similar photometry of a sample of galactic globular clusters shows that in the Clouds the metal abundance ranges from somewhat less than that of M15 and M92 to somewhat less than that of NGC 6356. In Fornax the lowest metal abundance appears to be significantly lower than that of M15, but a measurable range exists. Although the clusters in the Clouds follow the trend in metal abundance shown by clusters in our Galaxy, other as yet unknown factors besides interstellar reddening appear to cause scatter in this relationship. The special nature of the unusual globular clusters in the Clouds studied by Gascoigne and observed here is discussed, but strong conclusions are avoided. A brief discussion of the results on open clusters is given. (auth)

3251 INTEGRAL KERNELS AND EXACT SOLUTIONS TO SOME RADIATIVE PROBLEMS IN SPHERICAL GEOMETRIES. Schmid Burgk, J. (Univ., Heidelberg). Astrophys. J.; 181: No. 3, 865-874(1 May 1973).

Problems of radiative transfer in spherical geometries are investigated in the gray approximation by using a two-parameter family of absorption coefficients as functions of radial depth. The parameters describe the extent to which the atmosphere is actually dominated by geometric effects. With these absorption coefficients, kernels for the Fredholm equation for the mean intensity are calculated in analytic form. Exact solutions to the resulting Wiener–Hopf equation are presented for the case that the "degree of sphericity" remains constant throughout the atmosphere. Milne's problem is used for demonstration. The extent to which the radiation field remains anisotropic down to arbitrarily large optical depths (thus invalidating the unmodified Eddington approximation) is shown as well as the difference in surface intensities between plane-parallel and extended atmospheres. An approximate expression for the mean intensity is derived from the exact solution. (auth)

3252 CONDENSATIONS IN PLANETARY NEBULAE. Mottmann, J. (Univ. of California, Los Angeles). Astrophys. J.; 181: No. 3, 825-831(1 May 1973).

The observed low strengths of hydrogen radio recombination lines in planetary nebulae were investigated. The inclusion of a high degree of clumping in the nebular material is required to reduce the line enhancement predicted by non-LTE theory. Condensations with number densities of about 10^5 cm^{-3} seem to be required. The nature of such condensations is briefly discussed. (auth)

3253 SPECTROPHOTOMETRIC STUDIES OF NEBULAE. XXI. The Remarkable Planetary NGC 6778. Czyzak, S. J. (Perkins Observatory, Delaware, OH); Aller, L. H. Astrophys. J.; 181: No. 3, 817-823(1 May 1973).

The relatively faint planetary NGC 6778 is distinguished by an extraordinarily strong spectrum of permitted lines of C II, N II, N III, O II, O III, etc., and pronounced stratification effects. It is suggested that these permitted lines arise from direct excitation from the nucleus rather than by recombination in dense filaments. The [O III] and other forbidden lines seem weaker than in other planetaries; possibly this is indicative of lower abundances of the elements of the oxygen group. (auth)

3254 SEARCH FOR Ap STARS IN OPEN CLUSTERS. Young, A.; Martin, A. E. (California State Univ., San Diego). Astrophys. J.; 181: No. 3, 805-810(1 May 1973).

Low-dispersion spectrograms of 62 stars in 13 open clusters were observed in the intrinsic color range $-0.13 < B - V < +0.06$ in order to search for Ap stars. The purpose was to contribute to the statistics of the occurrence of Ap stars in homogeneous age groups, which is necessary as a critical test for some theories regarding the nature of Ap stars. Three new Ap stars were positively identified (all silicon-enhanced), and six other marginal candidates were noted. (auth)

3255 RELATIVSITIC BARYON EFFECTIVE MASSES AND THRESHOLDS FOR STRONGLY INTERACTING SUPERDENSE MATTER. Bowers, R.L. (Center for Relativity Theory, The University of Texas at Austin, Austin, Texas 78712); Campbell, J.A.; Zimmerman, R.L. Phys. Rev. D 8: No. 4, 1077-1087 (15 Aug 1973).

The relativistic effective mass of a baryon from the first SU(3)-symmetric octet is discussed. The calculation is based on a fully relativistic many-body theory for strongly interacting superdense matter. The dependence on interaction parameters is discussed. The resulting effective mass for high density becomes $m_{eff} \infty (a^2-1)^{1/2} q_F$. The density-independent coefficient a contains the baryon mass, exchanged pseudoscalar-meson mass, and coupling constant. The discussion employs analytic expressions which fit the results of numerical calculation to better than 10% over a density range $10^{13} < \rho_0 < 10^{21}$ g/cm^3. The reduction in pressure of asymptotic superdense matter and the effect of increased thresholds for particle production are discussed. Finally we mention the possible importance of density-dependent effective coupling constants. (auth)

3256 U OF T ASTRONOMER FINDS UNIQUE STAR. Garrison, R. F. (Univ. of Toronto). Can. Res. Develop.; 6: No. 2, 10(Mar 1973).

R. F. Garrison, of University of Toronto, has observed a new type of star. The star, known as CPD −31° 1701, shows only a helium spectrum, with other elements apparently absent. Previously observed helium stars have been "red giants", but this one more nearly resembles a "white dwarf". The new star is in the plane of the Milky Way, at a distance estimated as between 300 and 3,000 light years. (CA)

3257 INTERSTELLAR DUST AND DISTANCES TO PLANETARY NEBULAE. Lutz, J. H. (Univ. of Illinois, Chicago). Astrophys. J.; 181: No. 1, 135-145(1 Apr 1973).

UBV and Hγ data were used to construct diagrams of color excess versus distance for early-type stars within 1°.5 of six planetary nebulae. These diagrams were used in conjunction with the observed extinctions of the planetaries to derive distances for NGC 6741, NGC 6894, NGC 7026, NGC 7354, IC 1747, and IC 289. This method is independent of assumptions about optical thickness in the nebular shell or evolutionary stage. Assumptions of electron temperature and R, the ratio of total to selective absorption, are required. The method is limited in accuracy by the patchiness of the interstellar medium and by the possibility that R may vary from point to point in the Galaxy. (auth)

3258 WIDE MOVING PAIRS AMONG K AND M DWARFS. Lu, P. K. (Western Connecticut State Coll. Observatory, Danbury); Upgren, A. R. Astrophys. J.; 180: No. 1, 91-97(15 Feb 1973).

The phenomenon of moving pairs among nearby K and M dwarfs has been shown to be real and not the chance product of a random distribution. This result has already been found for the nearby A stars. Whether or not the pairs are only fine-structure details among moving stellar groups, they possess parallel space motions and their large spatial separations (typically 10 to 20 pc) do not usually permit their identification by any of the traditional observational methods of double stars. From a sample of 417 K3 V-M2 V stars listed in the McCormick or Michigan catalogs of nearby dwarfs for which space velocities can be determined, the incidence of wide pairs was found to be high and to include about 60 percent of the stars. This incidence is shown to be far higher than that which could be produced by a random distribution of the space velocities. The excess does not appear to vary from low- to high-velocity stars. This is interpreted to confirm that the frequency of pairs is independent of the ages of the stars and that the time of relaxation is long compared to the age of the Galaxy. (auth)

3259 NUCLEOSYNTHESIS OF THE FAR TRANSURANIUM ELEMENTS. Chechetkin, V. M. (Inst. of Applied Mathematics, Moscow). pp 50-54 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From All-Union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The nucleosynthesis of the heavier elements under conditions of high temperature and great density is considered. It is shown that the heavier elements probably were formed in the extremal "r" process under the condition of incomplete thermodynamic equilibrium. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

3260 TIDAL FRICTION IN SLOWLY ROTATING BLACK HOLES. Hartle, J.B. (Department of Physics, University of California, Santa Barbara, California, 93106). Phys. Rev. D 8: No. 4, 1010-1024 (15 Aug 1973).

A stationary distribution of matter outside a Kerr black hole will cause the angular momentum of the black hole to decrease with time provided the distribution is not symmetric about the axis defined by the black hole's angular momentum. The rate of decrease of angular momentum is calculated in the case that (a) the effects of the exterior matter can be treated as a perturbation to the Kerr geometry and (b) the angular momentum of the black hole is small. (auth)

3261 INTERFEROMETRIC OBSERVATIONS OF FORMALDEHYDE ABSORPTION IN FRONT OF STRONG GALACTIC SOURCES. Fomalont, E. B. (National Radio Astronomy Observatory, Green Bank, WV); Weliachew, L. Astrophys. J.; 181: No. 3, 781-794 (1 May 1973).

Observations were made of formaldehyde absorption at 4830 MHz in front of Sgr A, Sgr B2, W3, NGC 2024, W31, W33, W43, W49A, and W51. The Caltech interferometer, consisting of two 90-foot paraboloids, was used to synthesize a beam of $40'' \times 60'' \sec(\delta - l)$, where δ is the source declination and $l = 38°$. The main absorption features showed variations of optical depth over the sources, but there was no significant clumping. The previously determined isotopic ratio $^{12}C/^{13}C$ of 10 for Sgr A and Sgr B2 should be increased to $\sim 25 \pm 5$ for Sgr A and ≥ 20 for Sgr B2 because of the high optical depths at the center of the absorbing clouds, $\tau_{max} \sim 2.0$ for Sgr A, $\tau_{max} \gtrsim 3$ for Sgr B2. The +40 km s^{-1} cloud associated with Sgr A appears to be rotating as a solid body. The mass of the cloud is calculated to be $\sim 3 \times 10^5$ $M_{\odot}$. From neutral-hydrogen absorption data only a small proportion of the cloud is composed of atomic hydrogen; hence the cloud consists mainly of molecular hydrogen with a density $\sim 10^5$ cm^{-3}. (auth)

3262 MEASUREMENT OF THE LOCATION OF THE X-RAY SOURCE Cyg X-1. Miyamoto, S. (Tokyo Univ.); Fujii, M.; Matsuoka, M.; Nishimura, J.; Oda, M.; Ogawara, Y.; Ohta, S.; Wada, M. pp 2532-2533 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The location of Cyg X-1 was determined with balloon experiments. Three observations were performed by means of combinations of modulation collimators with angular periods of modulation 27 and 9 arcminutes and NaI(Tl) counters. The result is in agreement with that determined by the x-ray satellite Uhuru. The measurements altogether have considerably improved the accuracy of the previous location. Leiden Observatory recently detected a radio source at a location which coincides with that of Cyg X-1. (auth)

3263 POSSIBLE EVIDENCE FOR PULSED APPROX. 10^{12}-eV GAMMA RAYS FROM NP 0532. Grindlay, J. E. (Smithsonian Astrophysical Observatory, Cambridge, MA). pp 2535-2541 of Twelfth International Conference on Cosmic Rays. Vol. 7.

Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Using new experimental techniques for observing structure in the Cherenkov radiation produced in EAS that has been related previously, drift scans on the Crab Nebula with discrimination against the cosmic-ray background were made. A new upper limit for a $\geq 3\sigma$ detection of a continuous gamma-ray flux with $E_\gamma \geq 6 \times 10^{11}$ eV is reported as $F(\geq E_\gamma) < 3.5 \times 10^{-11}$ photon/cm^2 sec. The data (42 scans) recorded with information on absolute arrival time were analyzed at the correct period of NP 0532 and added in phase. Within 1 min of transit, a $\geq 4\sigma$ excess of candidate gamma-ray-initiated EAS arrived at the expected time of the interpulse of NP 0532. The implied ratio of interpulse to primary pulse is $\geq 5:1$, and the pulsed flux would correspond to $F(\geq 6 \times 10^{11}$ eV$) \sim 1.65 \pm 0.8 \times 10^{-11}$ photon/cm^2 sec, consistent with an extrapolation of the x-ray pulsed spectrum. (auth)

3264 OBSERVATIONS OF INTENSE 100-MICRON OBJECTS AT 3.5 MILLIMETER WAVELENGTH. Brown, R. L. (National Radio Astronomy Observatory, Green Bank, WV); Broderick, J. J. Astrophys. J.; 181: No. 1, 125-134(1 Apr 1973).

Measurements have been made at 85 GHz of 12 objects identified by Hoffman, Frederick, and Emery as sources of 100-μ emission in excess of 10^{-22} W cm^{-2} Hz^{-1}. In an attempt to detect the long-wavelength tail of the far-infrared spectral component, the observed 3.5-mm flux densities for each of the sources are compared with that expected from an extrapolation of the radio spectrum from lower frequencies: No unequivocal evidence is found for the presence of any contribution to the 85-GHz flux attributable to the presence of a high-frequency component. This result not only restricts a large class of models in which the 100-μ emission arises from nonthermal processes but it also requires that if the infrared radiation is due to thermal emission from dust grains then the temperature of those grains must exceed 20°K. Finally a plot of 100-μ flux density versus 3.5-mm flux density suggests a separation of the sources into two classes that may be quite distinct. (auth)

3265 REPORT ON A SEARCH FOR NEW OPTICAL PULSARS. Nelson, M. R.; Groth, E. J. (Princeton Univ., NJ). Astrophys. J.; 181: No. 1, 157-159(1 Apr 1973).

Using on-line digital techniques at the Princeton 36-inch (91-cm) telescope, time series were obtained on pulsar candidates drawn from five classes: single-line binary stars with anomalously heavy unseen companions (10 sources), recent novae (3), x-ray sources (4), extragalactic supernovae (1), and supernova remnants (1). The data were examined through autocorrelation and power-spectrum analyses for both narrow- and wide-band features. Typical spectral resolution was 10^{-3} Hz, while the maximum frequency varied from 50 to 5000 Hz. The system was tested by observing the one known optical pulsar. With this exception, no pulsation was detected down to the limits which are reported. (auth)

Solar Phenomena

Refer also to abstract 3246.

3266 DISTRIBUTION OF INFORMATION CHARACTERISTICS OF SOLAR-TERRESTRIAL RELATIONSHIPS. Velinov, P. I. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 7, 871-873(1973).

The effects of variations in solar activity on physical and biological processes in the Sun-Earth space were compared. It is concluded that the values and distributions of the information characteristics of some processes of heliogeophysical relations given in this communication testify to the purposefulness and effectiveness of the study of the effect of solar activity in the course of natural processes. (MHR)

3267 SYNCHROTRON RADIATION FROM THE MAGNETOPLASMA. Shukla, P. K. (Umeaa Univ., Sweden). Int. J. Electron.; 35: No. 4, 533-539(Oct 1973).

Numerical studies of the synchrotron radiation from relativistic electrons in the magnetoplasma are presented. Effects of a background medium on the synchrotron radiation is considered by means of a solar corona model. It is demonstrated that the low-frequency radiation is suppressed. (auth)

3268 ANALYSES OF THE ABSOLUTE SPECTRA OF SOLAR PROTONS ON THE BASIS OF GROUND MEASUREMENT DATA. Miroshnichenko, L. I. (Inst. of Terrestrial, Magnetism, and Radio-wave Propagation, Moscow); Petrov, V. M.; Tibanov, A. P. pp 2622-2627 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The method proposed by Miroshnichenko was used to develop the algorithm and the computer program for calculating the solar cosmic-ray spectra on the basis of the ground measurements in the particle rigidity range $R \geq 1$ GV. With this program, the absolute solar particle spectra were calculated for some flares in 1956-1967. The differential spectra obtained agree satisfactorily with the results of the direct measurements of the absolute solar particle flux beyond the atmosphere at $R \leq 1$ GV. The calculation results can be used to determine the absolute injection spectra in the high rigidity range (> 1 GV). (auth)

3269 DETERMINATION OF THE SOLAR PROTON INJECTION SPECTRUM IN TERMS OF VARIOUS DIFFUSION MODELS. Miroshnichenko, L. I. (Inst. of Terrestrial, Magnetism, and Radio-wave Propagation, Moscow). pp 2628-2634 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The available data on the absolute spectra of the protons accelerated on the Sun were analysed for some flares which occurred in 1956-1969. The data on the source particle spectrum (injection spectrum) were obtained in terms of various diffusion models. It is shown that in the rigidity range $R \geq 1$ GV different diffusion models give the values of $N_\odot(R)$ (total number of protons accelerated or injected by the flare) within the same order of magnitude. The differential rigidity spectra of the injection may be described, within the present-day accuracy of their determination, by the power function $\sim R^{-\gamma}$. Some evidence was obtained that the exponent γ varies from 1.5 to 2 at $R \leq 1$ GV to 3 to 4 at $1 \leq R \leq 5$ GV and to 5.5 at $R > 5$ GV. The possibility was also examined of representing the injection spectra in the exponential form $\exp(-R/R_\odot)$ where $R_\odot$ is the characteristic constant of the source spectrum. Evidence was also obtained that the exponential representation is not applicable for describing the injection spectrum in the total range of the solar particle rigidities. The independent data on $R_\odot$ are necessary to finally choose between the power and exponential representations of the spectra in various ranges of R. (auth)

3270 SOLAR PROTON, HELIUM, AND MEDIUM NUCLEI ($6 \leq Z \leq 9$) OBSERVED FROM THE IMP-VI SATELLITE. Von Rosenvinge, T. T.; McDonald, F. B.; Teegarden, B. J. (Goddard Space Flight Center, Greenbelt, MD). pp 2635-2640 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Proton, helium, and medium nuclei energy spectra were measured from the IMP-VI satellite for a recent solar flare. Above 2 MeV/N these spectra were based upon single and dual parameter pulse height analysis in addition to threshold rate counting. Pulse height analysis of medium nuclei was assigned a high priority for telemetry readout so that telemetry did not become saturated by the high proton intensity. In this manner the number of pulse height analyzed medium nuclei was increased by a factor of ~ 200. Individual medium nuclei were resolved in the energy interval 8 to 23 MeV/N. (auth)

3271 CHARGE AND ENERGY SPECTRA OF PARTICLES WITH $0.2 \leq E \leq 30$ MeV/nuc IN THE 25 JANUARY 1971 SOLAR FLARE. Price, P. B.; Sullivan, J. D. (Univ. of California, Berkeley). pp 2641-2646 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Tracks of 1000 solar particles with $Z \geq 10$ and 150 particles with $Z \cong 8$ were analyzed in a stack of plastic detectors exposed in a rocket during the Jan 25, 1971 flare. The energy spectra peaked at 1.5 MeV/N, with the flux falling to zero at ~0.4 MeV/N. Fe, Si, and O appeared to have similar energy spectra for energies between 2 and 12 MeV/N. Tentative abundances relative to Si with $2 \leq E \leq 5$ MeV/N were: 0 = 10 to 40; Si = 1.0; S < 0.25; Ar < 0.15; Ca < 0.2; Ti < 0.3; Cr < 0.4; Fe $\cong$ 1.8; Ni to Zn $\cong$ 0.05. Fe/Si was consistent with the revised high-Fe photospheric abundance. S/Si at 10 MeV/N was 0.16 which was significantly below the photospheric ratio. (auth)

3272 ANALYSIS OF PARTICLE PROPAGATION FROM SOLAR FLARES TO THE EARTH. Simnett, G. M. (Univ. of California, Riverside). pp 2647-2653 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A statistical analysis was made of the energetic particle data from solar events between May 24, 1967 and May 2, 1969, as observed by detectors on the IMP-4 satellite (Simnett, 1971). The delay time of relativistic electron events from the flash phase of the flare was examined. The results indicated a minimum delay time in the arrival of the first relativistic electrons of around 30 minutes for flares around W45, and longer for east longitude events. (WDM)

3273 DETERMINATION OF THE PARAMETERS OF SOLAR COSMIC RAY FLUX ON THE BASIS OF IONOSPHERIC DATA. Dorman, L. I. (Inst. of Terrestrial, Magnetism, and Radiowave Propagation, Moscow); Krupitskaya, T. M. pp 2654-2657 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

At present the long-lived satellites supply continuous information on the solar cosmic-ray flux in the low-energy range. However, the information on solar cosmic rays for previous years is also important to the study of the regularities in the generation and propagation of solar cosmic rays. Besides that, the data on the energy variations in the cosmic ray cut-off threshold in the high-latitude range are necessary to study the properties of the magnetospheric tail. To solve these problems a method is proposed for determining the parameters of solar cosmic rays and geomagnetic cut-off from the data on the profiles of the ionization rate q(h) obtained on the basis of ionospheric data. This method is applicable only in the case when one is sure that in the altitude range under consideration q(h) is completely due to cosmic rays. Examples of applications of the method are presented. (auth)

3274 SOLAR MODELS WITH INCREASED CONCENTRATION OF ^{3}He AND NEUTRINO FLUXES. Kocharov, G. E.; Starbunov, Yu. N. (Ioffe Inst. of Physics and Tech., Leningrad). pp 2865-2869 of Twelfth International Conference on Cosmic Rays. Vol. 7. Hobart, Australia; International Union of Pure and Applied Physics (1972).

From twelfth international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

As an advanced development of the authors' hypothesis about the low temperature source of energy production due to the burning of ^{3}He, solar models have been constructed for various concentrations of ^{3}He in the interior of the Sun. The values of the central temperature and the density of models and the neutrino fluxes are presented as a function of the ^{3}He concentration. To explain the results of Davis' experiment the concentration of $^3\mathrm{He} - X_3 = 3 \times 10^{-3}$ is sufficient. (auth)

Galaxies

Refer also to abstract 3193 and 3250.

3275 SPECTROPHOTOMETRIC RESULTS FROM THE COPERNICUS SATELLITE. II. Composition of Interstellar Clouds. Morton, D. C.; Drake, J. F.; Jenkins, E. B.; Rogerson, J. B.; Spitzer, L.; York, D. G. (Princeton Univ. Observatory, NJ). Astrophys. J.; 181: No. 3, L103-L109(1 May 1973).

Interstellar absorptions lines of H I, C I, C II, N I, N II, O I, Mg I, Mg II, Si II, Si III, Si IV, P II, S I, S II, S III, S IV, Cl II, Ar I, Mn II, and Fe II were identified in scans of one or more of the reddened stars ξ Per, α Cam, λ Ori, ζ Oph, and γ Ara. A curve-of-growth analysis of abundances shows that the ratios of Mg, P, Cl, and Mn to hydrogen are less than in the Sun by factors of about 4 to 10. Several of the other elements also are depleted in some of the stars. Excited levels in the ground terms of C I, C II, N II, and Si II also are present. (auth)

3276 SPECTROPHOTOMETRIC RESULTS FROM THE COPERNICUS SATELLITE. III. Ionization and Composition of the Intercloud Medium. Rogerson, J. B.; York, D. G.; Drake, J. F.; Jenkins, E. B.; Morton, D. C.; Spitzer, L. (Princeton Univ. Observatory, NJ). Astrophys. J.; 181: No. 3, L110-L115 (1 May 1973).

Interstellar lines were studied in the unreddened stars [$E(B-V) \leq 0.03$] λ Sco, ν Sco, α Leo, and α Eri, which are located between 20 and 150 pc from the Sun. The lines are on the linear and saturated Doppler portions of the curve of growth. Preliminary analysis showed that processes producing large amounts of highly ionized species are not dominant. Doubly ionized C, N, Si, and S were detected, but were all quite weak relative to the singly ionized species. Abundances relative to nitrogen were in the cosmic ratios or slightly lower, with some indication of general depletion of the heavier elements. Hydrogen number densities ranged from a measured value of 0.22 cm^{-3} for λ Sco to a derived value of 0.02 cm^{-3} for α Leo assuming nitrogen to have its solar abundance relative to hydrogen. (auth)

3277 SPECTROPHOTOMETRIC RESULTS FROM THE COPERNICUS SATELLITE. IV. Molecular Hydrogen in Interstellar Space. Spitzer, L.; Drake, J. F.; Jenkins, E. B.; Morton, D. C.; Rogerson, J. B.; York, D. G. (Princeton Univ. Observatory, NJ). Astrophys. J.; 181: No. 3, L116-L121(1 May 1973).

Strong H_2 lines were measured in all 11 reddened stars [$E(B-V) > 0.10$] observed; the fraction f of hydrogen gas in molecular form exceeded 10^{-1}. In eight out of nine unreddened stars [$E(B-V) < 0.05$] there was no trace of H_2 absorption, with f less than 10^{-7}. In two stars of intermediate reddening f was between 10^{-5} and 10^{-2}. The relatively large column densities in higher rotational levels, up to J = 5 or 6, corresponded to excitation temperatures mostly between 150° and 200°; the ratios of ortho-hydrogen (J = 1) to para-hydrogen (J = 0) corresponded to lower temperatures, averaging about 80°. Measures of two HD lines in nine stars indicated a ratio of HD to H_2 equal to about 10^{-6}; correction for the more rapid disruption of HD molecules, in the absence of effective optical shielding by many other such molecules, indicated that one HD molecule is formed and dissociated for about every 200 H_2 molecules. (auth)

3278 SPECTROPHOTOMETRIC RESULTS FROM THE COPERNICUS SATELLITE. V. Abundances of Molecules in Interstellar Clouds. Jenkins, E. B.; Drake, J. F.; Morton, D. C.; Rogerson, J. B.; Spitzer, L.; York, D. G. (Princeton Univ. Observatory, NJ). Astrophys. J.; 181: No. 3, L122-L127(1 May 1973).

Scans were made at the absorption wavelengths of CO, CO^+, CN^+, CS, C_2, OH, NO, NO^+, NH^+, SiO, MgH^+, and H_2O. Except for CO, no features were detected in the stars observed, with $E(B-V)$ ranging up to 0.3. The greatest abundance of CO was found in the direction of ζ Oph, where absorptions for several vibrational bands of the fourth-positive system were recorded by the low resolution detector and a column density of 4.6×10^{14} cm^{-2} was derived. The much stronger $C\,^1\Sigma + - X\,^1\Sigma +$ and $E\,^1\Pi - X\,^1\Sigma +$ transitions at 1087.9 and 1076.1 Å showed up in the high-resolution spectra of λ Ori, ξ Per, and α Cam, yielding column densities of 1.9×10^{13}, 3.1×10^{13}, and 3.5×10^{13} cm^{-2}, respectively. Comparison of the R(1) and P(1) lines to R(0) in the $C\,^1\Sigma + - X\,^1\Sigma +$ transition gave a rotational temperature of 5°K for CO toward these three stars. For a kinetic temperature of 20 to 50° this excitation is consistent with a number density of neutrals ranging from 10 to 100 cm^{-3} according to Goldsmith. (auth)

3279 DEUTERIUM IN INTERSTELLAR MOLECULES. Watson, W. D. (Univ. of Illinois, Urbana). Astrophys. J.; 181: No. 3, L129-L133(1 May 1973).

Isotope shifts of the Lyman bands of the HD molecule relative to those of H_2 are sufficient that the ultraviolet radiation which photodissociates HD in interstellar clouds is not appreciably attenuated by absorption due to H_2. In dense clouds this causes a larger fraction of hydrogen to exist as H_2 than deuterium to exist as HD if the rates of formation are equal. At the low temperatures of gas and grains in interstellar clouds, H_2 and HD are probably chemically unreactive. Then since H_2 and HD form first and lock up these atoms, the abundances of H and D in other molecules reflect their abundances in atomic form. It is shown that the ratio (atomic D/atomic H)/(total D/total H) approaches $\sqrt{[(\text{total H/total D})]}$ in the more dense regions (visual optical depths $\tau_{vis} \gtrsim 2$, typically) of clouds, and thus predict a similar enhancement for deuterium in molecules other than HD. For the usual abundance of deuterium (deuterium/hydrogen ~ 10^{-4}) the predicted enhancement is ~ 10^2, in excellent agreement with the observed (DCN/HCN) ratio. (auth)

3280 SPECTROPHOTOMETRY OF THREE EMISSION-LINE GALAXIES. Forrester, W. T. (Van Vleck Observatory, Middletown, CT). Astrophys. J.; 181: No. 3, 633-640(1 May 1973).

Spectrophotometric data concerning three blue emission-line galaxies were obtained from image-tube spectrograms secured with the 84-inch reflector of the Kitt Peak National Observatory. Analysis of these data indicated a level of excitation similar to that of low- or moderate-excitation galactic H II regions. The relative emission-line intensities and the shapes of the nuclear continuua over the blue and near-ultraviolet wavelengths indicated that a population of hot stars is responsible for both the gas excitation and the blue continuua. (auth)

3281 PARTICLE RESONANCE IN SPIRAL GALAXIES. Nonlinear Effects. Contopoulos, G. (Univ. of Maryland, Greenbelt). Astrophys. J.; 181: No. 3, 657-684(1 May 1973).

A theory is developed to account for the nonlinear effects, near the particle resonance, found by numerical integration. There are four equilibrium points in the rotating frame of reference: two of them unstable, at the minima of potential (L_1, L_2), and two stable, at the maxima of potential (L_4, L_5). Many particles are trapped in librating orbits around L_4, L_5. Using the lowest-order terms of a "third integral" of motion near L_4, L_5, the behavior of the trapped orbits is found and the approximate theoretical results are compared with the orbits found numerically by computer. An estimate of the trapped mass is given. It amounts to about 30 percent of the total mass between 9 and 11 kpc when the particle resonance is at r_s = 10 kpc and the maximum force due to the spiral is 4 percent of the axisymmetric force. Some effects due to these mass concentrations are found numerically and theoretically. (auth)

3282 PATTERNS OF WAVES IN GALACTIC DISKS. Hunter, C. (Florida State Univ., Tallahassee). Astrophys. J.; 181: No. 3, 685-705(1 May 1973).

The ray methods of geometrical optics are used to calculate both steady and unsteady patterns of waves produced by localized sources in galactic disks. Caustics or ray envelopes are shown to form in a number of instances, and are important because they mark the most prominent features of wave patterns. Unsteady spiral wave patterns in a stellar disk can have caustics that propagate both toward and away from the galactic center. The study of these waves in a specific model shows that one-armed spiral waves have the widest range of propagation, can propagate into the galactic center and be reflected there, and allow the development of leading as well as trailing spiral wave patterns. (auth)

3283 INTERSTELLAR GAS ABUNDANCES FROM ROCKET OBSERVATIONS OF ULTRAVIOLET ABSORPTION LINES. Jenkins, E. B. (Princeton Univ. Observatory, NJ). Astrophys. J.; 181: No. 3, 761-779(1 May 1973).

Absorption lines from the ground states of O I, C II, and Si II were observed in the ultraviolet spectra of δ, τ, λ, κ, and ν Sco, ζ Oph, and ζ Per, which were photographed on three Aerobee sounding rocket flights. While the oxygen and silicon absorptions are purely interstellar, some of the C II absorption arises from the star's atmosphere and some presumably from gas in the H II region near the star. In the analysis of the lines the absorption by C II in the H I regions was isolated from the other two sources. Curves of growth for the ultraviolet lines were derived from visual absorption-line profiles, when available. Absorptions by C I were marginally registered in some spectra, and N I was observed toward δ Sco. When compared with H I column densities from the Lα absorptions, the amounts of O I and Si II are consistent with the cosmic abundance ratios. C II, on the other hand, appears for various stars to be from 3 to 10 times overabundant, although in some cases the errors are large. If much of the interstellar hydrogen is ionized or in the form of H_2, the observed amount of carbon would be easier to reconcile with the cosmic composition. In principle, overestimates of the element abundances could result if a very small percentage of the gas has an extraordinarily large velocity dispersion and anomalously broadens these highly saturated absorption lines. (auth)

3284 INTERSTELLAR CO^+/CO ABUNDANCE RATIO. Hobbs, L. M. (Yerkes Observatory, Chicago). Astrophys. J.; 181: No. 3, 795-798(1 May 1973).

A search at high sensitivity for interstellar absorption in the λ 4250 line of CO^+ yields negative results toward 14 stars, despite the pervasive presence of large amounts of CO in the interstellar gas. This result is in accord with theory, but still lacks by a large factor sufficient sensitivity to test any details of the theory. (auth)

3285 DO INTERSTELLAR GAS CLOUDS EXIST BETWEEN SPIRAL ARMS. Quirk, W. J. (California Inst. of Tech., Pasadena). Astrophys. J.; 180: No. 1, 25-30(15 Feb 1973).

This paper discusses what can happen to clouds as they move from arm regions to interarm regions, through a density-wave shock, and back to arm regions again. Shu et al. have taken the viewpoint that interstellar clouds will survive the trip between arms. Biermann et al. have taken the viewpoint that they will not. It is pointed out that cloud–cloud collisions and other processes may lead to the destruction of interstellar clouds in less time than the 10^8 years it takes clouds to travel across arms. A possible observational test is suggested to distinguish between the two possibilities. (auth)

3286 CLUSTER OF GALAXIES ABELL 2670. Oemler, A., Jr. (California Inst. of Tech., Pasadena). Astrophys. J.; 180: No. 1, 11-23(15 Feb 1973).

Abell 2670 is a rich, compact cluster of galaxies dominated by a very large central cD galaxy. A new method of galaxy photometry was used to obtain its luminosity function, which resembles that of Coma and other clusters. The cD galaxy has an elliptical-galaxy core and a diffuse envelope which was traced to almost 1 Mpc and which probably fills the cluster. On the assumption that it does, the mass-to-light ratio of the cluster is $255 \pm 117\ M_\odot/L_\odot$. (auth)

3287 SPECTROSCOPY OF OUTLYING FAINT GALAXIES IN THE REGION OF THE COMA CLUSTER. Tifft, W. G.; Gregory, S. A. (Univ. of Arizona, Tucson). Astrophys. J.; 181: No. 1, 15-17(1 Apr 1973).

Redshifts are reported for 27 outlying galaxies in Coma. Twenty-four have redshifts typical for Coma galaxies, and 11 galaxies show emission lines. (auth)

3288 TIDALLY TRUNCATED ELLIPTICAL GALAXY. King, I. R.; Kiser, J. (Univ. of California, Berkeley). Astrophys. J.; 181: No. 1, 27-30(1 Apr 1973).

Surface photometry of the elliptical companion of NGC 5846 shows that it lacks an extended envelope but instead has a profile resembling that of a low-concentration star cluster. It appears to be tidally limited by its giant neighbor. (auth)

3289 SOUTHERN GALAXIES. IV. Luminosity Distribution in the Seyfert Galaxy NGC 1566. de Vaucouleurs, G. (Univ. of Texas, Austin). Astrophys. J.; 181: No. 1, 31-50(1 Apr 1973).

Isophotes, luminosity profiles, and photometric parameters of the brightest southern Seyfert galaxy NGC 1566, revised type SAB(s)bc, are derived from long- and short-exposure photographs taken with the Mount Stromlo 75-cm reflector and the Cordoba 152-cm reflector. (WDM)

3290 STELLAR MOTIONS NEAR THE NUCLEUS OF M31. Rubin, V. C.; Ford, W. K. Jr.; Kumar, C. K. (Carnegie Inst. of Washington, DC). Astrophys. J.; 181: No. 1, 61-77(1 Apr 1973).

Velocities of stars along the major and minor axes in the nuclear bulge of M31 were measured from the λ5269 Fraunhofer E absorption line (Fe I + Ca I). The mean uncertainty of each velocity was estimated to be 25 km s^{-1}. In general, the stellar velocities resembled the gas velocities reported earlier. Along the major axis, the velocities rose steeply across the nucleus, and showed a minimum at R = 1600 pc. Along the far minor axis, 300 pc < R < 800 pc, excess positive velocities were observed in those regions where gas was observed to be streaming out from the nucleus. These regions of anomalous velocities appeared to be coincident with spiral features. However, no realistic explanation of the complex stellar motions, or of their relation to the presumably younger gas, can be offered. (auth)

3291 INTERFEROMETRIC STUDIES OF INTERSTELLAR CH^+ MOLECULES. Hobbs, L. M. (Yerkes Observatory, William Bay, WI). Astrophys. J.; 181: No. 1, 79-93(1 Apr 1973).

Interferometric, photoelectric scans of the interstellar λ4232 line of CH^+ were obtained for 28 stars at a resolving power of 300,000. The limiting detectable equivalent widths were near 1 mÅ for many stars, and were near 0.5 mÅ for a few selected stars, so that a number of new, weak lines were detected. The column densities of CH^+ were roughly comparable, on the average, to those of Na I and Ca II, with $[N(CH^+)/N(Na\ I)] = 0.3$ and $[N(CH^+)/N(Ca\ II)] = 0.9$. The results imply that $[N(CH^+)/N(H\ I)] \sim 1 \times 10^{-9}$. The detailed agreement among the velocity distribution functions for the CH^+, Na I, and Ca II absorbers suggests that all three species generally coexist throughout the low-density clouds sampled here; the full widths at half-maximum of these functions typically are a few kilometers per second. The observations are compared with theoretical predictions concerning interstellar CH^+ molecules. (auth)

3292 FORMATION OF INTERSTELLAR MOLECULES FROM NEGATIVE IONS. Dalgarno, A. (Harvard Coll. Observatory, Cambridge, MA); McCray, R. A. Astrophys. J.; 181: No. 1, 95-100(1 Apr 1973).

The possible contribution of chemical reactions involving negative ions to the formation of interstellar molecules is briefly explored. (auth)

3293 ELECTROSTATIC POTENTIAL OF INTERSTELLAR GRAINS. Feuerbacher, B.; Willis, R. F.; Fitton, B. (European Space Research Organization, Noordwijk, Netherlands). Astrophys. J.; 181: No. 1, 101-113(1 Apr 1973).

The equilibrium electrostatic potential of interstellar grains, subjected to an ultraviolet radiation field in a dilute ambient plasma, is calculated for a variety of radiation fields and plasma parameters, and for two different grain materials. For an environment typical of an H I region, the results show that the various components of interstellar grains in the multicomponent model may charge to opposite potentials, thus favoring the formation of mixed composite grains due to Coulomb attraction. In H II regions, a three-shell model of the grain charge is presented, which includes a sphere of positively charged grains around the central star bounded by a transition region in which grains of low and of high photoyield are oppositely charged. Here grain growth and the formation of mixed composite grains may take place. In the outer shell all grains are charged negative. Estimated radii of these shells are given for exciting B0 and O5-type stars. (auth)

3294 FLEXURAL FREQUENCIES OF CYLINDRICAL GRAVITATIONAL WAVE DETECTORS. Gram, R. Q. (Univ. of Rochester, NY); Douglass, D. H.; Tyson, J. A. Rev. Sci. Instrum.; 44: No. 7, 857-859(Jul 1973).

Calculated flexural frequencies of right circular cylinders are presented as a function of diameter-to-length ratio for a Poisson's ratio of 0.333. The uniform spacing between modes observed for large length/diameter vanishes for wavelengths comparable to the diameter, with some adjacent modes changing order. Experimental verification of the results is presented. (auth)

Cosmology

3295 NEUTRINO SEA IN THE UNIVERSE AND THE STRUCTURE OF SPACE-TIME. Kochowicz, B. (Univ., Warsaw). Acta Phys. Pol.; B4: No. 5, 655-657(1973).

Observational and theoretical aspects of a possible presence of a neutrino background in the Universe are considered. Observable effects are related to the still open question of "missing mass" in clusters of galaxies. The presence of the neutrino sea can prove decisive in recognizing the proper structure of the space-time. (auth)

3296 SCALAR WAVES IN THE MIXMASTER UNIVERSE. I. THE HELMHOLTZ EQUATION IN A FIXED BACKGROUND. Hu, B.L. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 8: No. 4, 1048-1060 (15 Aug 1973).

Solutions to the scalar wave equation in a fixed mixmaster background are presented. Separability conditions on the Laplace-Beltrami equation are related to the complete sets of invariant operators of the symmetry group SO_3. Solutions to the Helmholtz equation are equivalent to the quantum-mechanical problem of asymmetric rotors. The wave functions in the mixmaster space are the asymmetric-top wave functions. In Euler angle variables, they are expanded in terms of the symmetric-top wave functions (the wave functions in Taub space) possessing definite (J, K, M) symmetries, with a coupling in the intrinsic magnetic quantum number K; the case with $M = 0$ can be expressed as a product of the Lamé functions in elliptic coordinates. Invariance of the mixmaster space under the four-group characterizes the wave functions into four symmetry species and causes the factorization of the energy matrix into four submatrices. Eigenvalues and expansion coefficients for the wave functions are calculated for some low-lying levels. (auth)

3297 GRAVITATIONAL-WAVE ANTENNA DESIGN TO DETECT RANDOM GRAVITATIONAL WAVES. Burke, W.L. (Lick Observatory, Boards of Studies in Astronomy and Astrophysics, and Physics, University of California, Santa Cruz, California 95060). Phys. Rev. D 8: No. 4, 1030-1035 (15 Aug 1973).

A design is proposed for an antenna system capable of detecting random gravitational waves and separating their effects from random fluctuations in the antenna. The strongest known signal should be the random signal from all of the binary stars in the galaxy. This design may allow one to penetrate the background noise of the Earth itself and recover this signal. (auth)

3298 DEVIATION OF AN EXPANDING UNIVERSE WHICH ON THE AVERAGE IS ISOTROPIC, FROM THE FRIEDMAN UNIVERSE. Byalko, A. V. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 3, 849-861(Sep 1973). (In Russian).

Expansion of a Universe, which on the average is isotropic, is considered at the stage of applicability of the equation of state $p = \epsilon/3$. A high-frequency expansion of the Einstein equations is carried out under the assumption that the characteristic wavelengths of the metric deviations from an isotropic one are much smaller than the radius of curvature. Averaging of the equations derived over large scales yields the deviation of the Universe expansion from the isotropic Friedman solution which is due to the inverse effect of high-frequency metric perturbations. The dependence of the metric perturbation amplitudes for the high-frequency expansion differs from that obtained on analysis of linear perturbations by a logarithmically slowly varying factor. (auth)

Planetary Phenomena

Refer also to abstract 4433.

3299 STATISTICAL MECHANICS OF LIGHT ELEMENTS AT HIGH PRESSURE. III. Molecular Hydrogen. Slattery, W. L.; Hubbard, W. B. (Univ. of Texas, Austin). Astrophys. J.; 181: No. 3, 1031-1038(1 May 1973).

The high-pressure thermodynamic properties of a molecular hydrogen fluid are calculated in the classical domain using a Monte Carlo approach. A recent theoretical intermolecular potential of the exp − 6 form which gives good agreement with low-pressure experimental data, and fair agreement with high-pressure data, is used. Melting curves and adiabats with relevance to planetary models are calculated. A possible application of the theory of pressure-induced opacity in molecular hydrogen is noted. (auth)

3300 POLAR CAP MAGNETIC VARIATIONS AND THEIR RELATIONSHIP WITH THE INTERPLANETARY MAGNETIC SECTOR STRUCTURE. Svalgaard, L. (Stanford Univ., CA). J. Geophys. Res.; 78: No. 13, 2064-2078(1 May 1973).

The relationship between polar geomagnetic variations and the polarity of the interplanetary magnetic sectors has been studied for the quiet year 1965. It is found that during the day hours a system of ionospheric currents encircles the magnetic poles on every day. The current system may extend up to 15° from the pole but is strongest at 8° to 10° invariant colatitude. The current direction as seen from near the magnetic poles is counterclockwise during interplanetary sectors with field pointing away from the sun and clockwise during toward sectors. The current strength is dependent on season, being strongest during local summer. When the magnetic pole is on the nightside of the earth, this polar cap current is absent or very weak. When the rotation of the earth brings the magnetic pole into the dayside, the polar cap current system develops, with the current being most concentrated in the part of the current system that is nearest to the noon meridian. The current increases its total intensity until the magnetic pole is rotated past the noon meridian; then the intensity decreases as the magnetic pole approaches the nightside again. The seasonal variation of the magnetic elements in the polar cap is discussed in view of the sector polarity effects. These effects introduce an important modulation of the seasonal variations of the geomagnetic polar field. The demonstration of current systems inside the polar caps encircling the magnetic poles during local day hours calls for a major revision of the generally accepted picture of polar cap geomagnetic variations. It also suggests a new framework for interpreting polar cap observations of geomagnetic and related phenomena. (auth)

3301 IDENTIFICATION OF INTERPLANETARY TANGENTIAL AND ROTATIONAL DISCONTINUITIES. Smith, E. J. (Jet Propulsion Lab., Pasadena, CA). J. Geophys. Res.; 78: No. 13, 2054-2063(1 May 1973).

Discontinuities in the interplanetary magnetic field detected by the Mariner 5 magnetometer have been analyzed to distinguish tangential and rotational discontinuities. The method used was based on finding the field component normal to the plane of the discontinuities that vanishes for tangential discontinuities and is nonzero for rotational discontinuities. The normal to each discontinuity was obtained by a variance analysis of the field vectors on both sides and within the current layer to find the direction of minimum field variation. Supplementary information concerning the existence or absence of changes in field magnitude across the discontinuities was also used to permit an unambiguous identification of both tangential and rotational discontinuities. Slightly less than one half of the 118 discontinuities analyzed could not be classified because neither the normal component nor the changes in field magnitude were statistically significant owing to errors in the field measurements and in finding the normal direction. The 44 rotational discontinuities that were finally identified did not exhibit changes in field magnitude in excess of 20%, an uncertainty that is consistent with the anticipated maximum error in measurement. (auth)

3302 ALFVEN WAVE REFRACTION BY INTERPLANETARY INHOMOGENEITIES. Daily, W. D. (Ames Research Center, Moffett Field, CA). J. Geophys. Res.; 78: No. 13, 2043-2053 (1 May 1973).

Pioneer 6 magnetic data reveal that the propagation direction of Alfvén waves in the interplanetary medium is strongly oriented along the ambient field. Magnetic fluctuations of frequencies up to $^1/_{30}$ sec in the spacecraft frame are shown to satisfy a necessary condition for Alfvén waves, and a variance matrix analysis is used

to determine the Alfvén wave normal. It appears from this analysis that geometrical hydromagnetics may satisfactorily describe deviation of the wave normal from the background field. The rotational discontinuity is likely also to propagate along the field lines. (auth)

3303 INDUCED MAGNETOSPHERE OF THE MOON. 1. Theory. Schubert, G. (Univ. of California, Los Angeles); Sonett, C. P.; Schwartz, K.; Lee, H. J. J. Geophys. Res.; 78: No. 13, 2094-2110(1 May 1973).

An analytic solution for the magnetic field in the space defined by a spherical moon and its downstream cylindrical cavity formed by the solar wind is derived for interplanetary magnetic fields both parallel and perpendicular to the cavity axis. By superposition, the solution is obtained for arbitrary orientations of the interplanetary field. The theory is quasi-static and is formulated in terms of a scalar magnetic potential. Thus the moon model consists of a core of arbitrary size and infinite electrical conductivity surrounded by a nonconducting shell; the cavity volume is also assumed to be nonconducting. The variation of the magnetic field on the lunar surface (both sunlit and dark hemispheres) and on the cavity boundary is presented for various values of core radius. The solution also yields the distribution of currents on the lunar sunlit surface and the surface of the cavity. Theoretical transfer functions are also presented, and their variations with position on the lunar surface and with core size are discussed. The results are compared with those of spherically symmetric approximations to lunar magnetic induction. (auth)

3304 OBSERVED PROPERTIES OF INTERPLANETARY ROTATIONAL DISCONTINUITIES. Smith, E. J. (Jet Propulsion Lab., Pasadena, CA). J. Geophys. Res.; 78: No. 13, 2088-2093 (1 May 1973).

In a prior study, discontinuities were identified as tangential or rotational principally on the basis of the existence or absence of a magnetic field component perpendicular to the plane of the discontinuity. The observed properties of the rotational discontinuities are described. The normals to the discontinuities were subjected to a variance analysis and did not exhibit a statistically significant anisotropy. These normals appear to be randomly oriented. Since rotational discontinuities are large-amplitude Alfvén waves, the transverse perturbation in the magnetic field implies a corresponding jump in the solar wind velocity that is often only slightly less than the Alfvén speed. The rotational discontinuities identified are all circularly polarized and transport vorticity and angular momentum. No preferred sense of polarization is found, however, and both right-hand and left-hand polarizations occur with equal probability in the spacecraft frame. (auth)

3305 SEARCH FOR FAR-ULTRAVIOLET EMISSIONS FROM THE LUNAR ATMOSPHERE. Fastie, W. G. (Johns Hopkins Univ., Baltimore, MD); Feldman, P. D.; Henry, R. C.; Moos, H. W.; Barth, C. A.; Thomas, G. E.; Donahue, T. M. Science; 182: No. 4113, 710-711(16 Nov 1973).

An ultraviolet spectrometer aboard the Apollo 17 orbiting spacecraft attempted to measure ultraviolet emissions from the lunar atmosphere. The only emissions observed were from a transient atmosphere introduced by the lunar landing engine. The absence of atomic hydrogen implies that solar wind protons are converted to hydrogen molecules at the lunar surface. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 4137.

3306 (COO-2200-3) NUMERICAL SIMULATION OF WHISTLER WAVE PROPAGATION. Denavit, J. (Northwestern Univ., Evanston, Ill. (USA)). 30 Sep 1973. Contract AT(11-1)-2200. 41p. Dep. NTIS $4.25.

A particle code was written using weighted particles and a quiet start technique to simulate the nonlinear propagation of whistler waves parallel to an external magnetic field. The algorithm is derived from the Darwin Lagrangian by a variational method and two versions of the code are considered, using linear and quadratic base function. Numerical effect due to the discrete initial loading of the particles in parallel velocities, perpendicular velocity phase angles, and positions are analysed; and the performance of the linear and quadratic versions of the code are compared. (auth)

3307 (UCRL-51456) GEOGRAPHICAL DISTRIBUTION OF APPROX. 100-keV ELECTRONS ABOVE THE EARTH'S ATMOSPHERE. Seward, F. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Oct 1973. Contract W-7405-eng-48. 11p. Dep. NTIS $4.00.

Previously unpublished satellite data is used to show the distribution of ~100-keV electrons above the Earth's atmosphere. Specific regions of high counting rate are mapped at altitudes of 300 to 400 km. These regions are used to predict the suitability of various launch sites for rocket-borne x-ray astronomical experiments. (auth)

3308 SPORADIC E LAYER AND THE VARIATION OF THE GEOMAGNETIC FIELD. Khydyrov, A. Izv. Akad. Nauk Turkm. SSR, Ser. Fiz.-Tekh., Khim. Geol. Nauk; No. 3, 49-54(1973). (In Russian).

Detailed study of the relation between the sporadic E layer and geomagnetic field variations to confirm the mechanism of formation of the sporadic E layer. It is found that the correlation coefficients between the sporadic E layer critical frequency and the H component of the geomagnetic field assume different values. It is shown that variation of the sporadic E layer critical frequency and screening frequency has no effect on the H-component of the geomagnetic field. (IAA)

3309 ATMOSPHERIC GRAVITY WAVE OBSERVATIONS AFTER THE SOLAR ECLIPSE OF JUNE 30, 1973. Schoedel, J. P.; Klostermeyer, J.; Roettger, J. (Max-Planck-Institut fuer Aeronomie, Lindau/Harz, Ger.). Nature (London); 245: No. 5420, 87-88(14 Sep 1973).

It has been suggested that during a solar eclipse gravity waves are generated by the Moon's shadow moving with supersonic speed through the Earth's atmosphere. The solar eclipse of 30 June, 1973, over the North Atlantic and Africa provided an opportunity to endeavour to identify such eclipse-generated gravity waves, and tracing calculations were performed together with predictions of positions and times at which, as a consequence of the curved eclipse path, focusing of the waves should occur. Experiments are described which were made at the field station Tsumeb (operated by the Max-Planck-Institut fuer Aeronomie) which lies near the predicted focus of the south-going waves; these consisted of (1) vertical incidence ionograms, taken every 5 m, (2) recording of the Faraday rotation angle of the 137 MH$_z$ signal of the geostationary satellite Intelsat II F3, (3) F-region TIDs by means of hf ground-backscatter ionograms taken every 4 m, and (4) microbarograph recorded ground pressure variations. From the data obtained it was found that no eclipse-generated atmospheric gravity waves could be detected near the predicted focusing area over SW Africa. (UK)

3310 SPATIAL SEPARATION OF 3914- AND 3160-A EMISSIONS OF NITROGEN IN AN AURORA. Henrist, M. (Univ., Liege). J. Geophys. Res.; 78: No. 13, 2350-2352(1 May 1973).

An event is reported that deals with the second positive ($C^3\Pi_u$–$B^3\Pi_g$) and first negative ($B^2\Sigma_u^+ - X^2\Sigma_g^+$) systems of nitrogen. (MHR)

3311 COMMENT ON PAPER BY D. C. CARTWRIGHT, S. TRAJMAR, AND W. WILLIAMS, "VIBRATIONAL POPULATION OF THE $A^3\Sigma_u^+$ and $B^3\Pi_g$ STATES OF N_2 IN NORMAL AURORAS." Shemansky, D. E. (Univ. of Pittsburgh); Broadfoot, A. L. J. Geophys. Res.; 78: No. 13, 2357-2373(1 May 1973).

Recent theoretical calculations have given rise to the declared but unobserved presence of strong auroral emissions in the N_2 $A^3\Sigma_u^+$-$B^3\Pi_g$ and $W^3\Delta_u$-$B^3\Pi_g$ systems. It is suggested that the quantities involved are too uncertain for one to arrive at a well-defined conclusion on the basis of the theoretical calculations alone. Laboratory evidence at low pressures gives no direct indication of the presence of the systems, although this lack may be due to high radiationless deactivation rates of the $W^3\Delta_u$ and $A^3\Sigma_u^+$ states. However, the presence of the transitions at the indicated rates should be easily detectable in the measured auroral population rates of the $B^3\Pi_g$ state. According to averaged auroral measurements accumulated over the years, there is no evidence for significant contributions from the two systems in question. (auth)

3312 COSMIC RAY IONIZATION IN THE D REGION AT SUNRISE: EVIDENCE FROM VLF PHASE MEASUREMENTS. Abdu, M. A.; Ananthakrishnan, S.; Krishnan, B. A.; Massambani, O. (Universidade Mackenzie, Sao Paulo, Brazil). Radio Sci.; 8: No. 8-9, 733-736(1973).

A temporary phase recovery observed on long-distance VLF propagation paths at sunrise is shown to be associated with cosmic-ray ionization. Simultaneous measurements of the phase carried out at Atibaia, Sao Paulo, and Jaguarao, Rio Grande do Sul, appear to demonstrate a latitudinal effect in this phenomenon. (auth)

3313 IRREGULARITY MOTIONS IN THE POLAR IONOSPHERE. Basler, R. P. (Stanford Research Inst., Menlo Park, CA); Scott, T. D.; DuPuy, R. L. Radio Sci.; 8: No. 8-9, 745-751 (1973).

The frequency spectrum of a CW HF radio signal transmitted from an aircraft and propagated over a 1-hop path inside the polar cap was recorded for about 50 nighttime hr during August 1967. Two different general types of disturbance were observed in these records: (a) a diffuse spectral broadening which was always present to some extent, even under quiet conditions, but which on some occasions was increased by as much as a factor of 2; and (b) discrete frequency anomalies, which were recorded at a rate of about two per hour, and which generally appeared above the carrier frequency (about 9 MHz) and decreased in frequency with a median slope of −2.2 Hz min^{-1}. These discrete anomalies can be interpreted most satisfactorily in terms of Doppler-shifted reflections from moving ionospheric irregularities. On the basis of this interpretation, the observations are taken to show that irregularity velocities are often in the range from 0.5 to 1.0 km sec^{-1}, with a preferred direction of motion roughly toward the quadrant from geographic E to S and centered on geomagnetic E. However, the measurements were relatively insensitive to geomagnetic N-S movements and to low velocities. (auth)

3314 SCATTERING OF HF RADIO WAVES BY ELLIPTICAL ELECTRON-DENSITY DISTRIBUTION. Corbin, V. L.; Klein, M. M. (Air Force Cambridge Research Labs., Bedford, MA). Radio Sci., 8: No. 8-9, 753-756(1973).

The differential cross sections for an ellipsoid and elliptic cylinders having Gaussian electron-density distributions have been obtained by a ray-tracing procedure. Calculations for the case of an external magnetic field were restricted to the ellipsoidal distribution. The results show that the scattering is extremely sensitive to the orientation of the body. A peak in cross section occurs at the scattering angle corresponding to the ray normal to the critical surface, and increases as the surface becomes flatter. The cross section is sensitive to the ratio of peak density to critical density for moderate values but becomes relatively insensitive when the ratio exceeds 3. The total cross section (shown only for the elliptic cylinder) is a very sensitive function of both orientation and ratio of major to minor axes. The introduction of a magnetic field decreases the ordinary ray cross section; the extraordinary ray exhibits higher cross-sectional values than the nonmagnetic field case. Comparison of the Gaussian ellipsoid with the corresponding conducting ellipsoid shows that the Gaussian has a larger cross section in the forward region but considerably lower values in the backscatter region. (auth)

3315 CONJUGATE PHOTOELECTRON EXCITATION OF O I 4368 AIRGLOW EMISSION. Christensen, A. B. (Univ. of Texas, Dallas); Teixeira, N. R.; Angreji, P. D. J. Geophys. Res.; 78: No. 13, 2315-2323(1 May 1973).

Conjugate photoelectron fluxes are shown to be mainly responsible for the excitation of O I 4368 radiation observed with a grille spectrometer located at Langmuir Laboratory, New Mexico (L = 1.7). On the basis of observations of O I 7774 and 4368 tropical emissions at Agulhas, Negras, Brazil (L = 1.1), the contribution of radiative recombination to the New Mexico intensity is shown to be small. Conjugate photoelectron excitation at the Brazilian site has not been observed. (auth)

3316 ACOUSTIC-GRAVITY MODES AND LARGE-SCALE TRAVELING IONOSPHERIC DISTURBANCES OF A REALISTIC, DISSIPATIVE ATMOSPHERE. Francis, S. H. (Bell Labs., Whippany, NJ). J. Geophys. Res.; 78: No. 13, 2278-2301(1 May 1973).

The guided acoustic-gravity modes that can propagate in a realistic dissipative atmosphere are computed for periods between 30 sec and 2 hours. The analysis differs from previous treatments by including dissipation (viscosity and thermal conductivity) and by using a realistic sound speed profile throughout the thermosphere. The presence of realistic dissipation allows a unique determination of the acoustic-gravity mode spectrum free from ambiguities related to the choice of the upper boundary condition. Since the atmospheric model below the thermosphere is similar to those used in previous studies, the characteristics of the lower atmospheric modes (e.g., the Lamb mode) are essentially unchanged from previous analyses of fully ducted modes in dissipationless atmospheres. The attenuation distances of these lower atmospheric modes, defined as the distances required for the modes to be attenuated by a factor of 1/e, are of the order of the earth's circumference or greater. The upper atmospheric modes, on the other hand, exhibit several characteristics that disagree with the results of previous analyses. The calculations reported here reveal the existence of several long-period modes with average speeds between 300 and 700 m/sec, all composed of F region heights of internal gravity waves with nearly horizontal phase fronts. Their attenuation distances are of the order of ⅛ of the way around the earth or less. All the properties of these upper atmospheric modes agree qualitatively with the observed characteristics of large-scale F region traveling disturbances (TID's). Ion drag is not found to be particularly important, but changes of thermospheric temperature due to diurnal and solar cycle variations are found to have quite appreciable effects on the upper atmospheric modes. (auth)

3317 MAGNETIC STORM CHARACTERISTICS OF THE THERMOSPHERE. Mayr, H. G. (Goddard Space Flight Center, Greenbelt, MD); Volland, H. J. Geophys. Res.; 78: No. 13, 2251-2264(1 May 1973).

Energy and diffusive mass transport associated with the thermospheric circulation are considered in a self-consistent, though mathematically relatively simple, form to describe in a three-dimensional two-constituent model magnetic storm characteristics in composition (N_2, O, and He), temperature, and mass-density. It is shown that during disturbed conditions the latitudinal variations of composition and gas temperature T_g reflect the local nature of the magnetic storm heat input assumed to be primarily confined to the auroral zones. Thereby T_g and N_2 increase, He decreases, and O remains constant through the auroral zones at exospheric heights (due to the superposition of temperature and diffusion effects) in agreement with Ogo 6 mass spectrometer measurements. In contrast, the magnetic storm response in the total mass density is characterized by a strong worldwide component and a relatively insignificant increase toward the poles, with the density peak occurring between 2 (poles) and 8 (equator) hours after the maximum energy input, in substantial agreement with satellite drag data. While in situ composition and satellite drag mass-density measurements can thus be reconciled, it must, however, be emphasized that the temperature derivation from the satellite drag data cannot be justified during disturbed conditions. (auth)

Magnetospheric Phenomena

3318 (TRITA-EPP-73-9) QUASI-LINEAR APPROACH FOR BOUNCE AND DRIFT RESONANCE INTERACTIONS OF TRAPPED PARTICLES IN THE MAGNETOSPHERE. Ishihara, T.; Tamao, T. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). Apr 1973. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

Starting from the drift kinetic equation for guiding center distribution function, quasi-linear diffusion equation for the hybrid interaction between the bounce and drift resonances of trapped particles with random field fluctuations are considered for both cases of electrostatic and electromagnetic disturbances. In addition to the usual diffusion term, there is a friction term for particle transport in the case of electromagnetic fluctuations, which takes its maximum value, when the phase difference between the parallel magnetic component to the ambient field line and the perpendicular electric field is just $\pi/2$. Compared with the case of pure drift resonance, the stochastic interaction due to the bouncing motion has a tendency to decrease the diffusion coefficient, and this effect is appreciable for the fluctuations with the relatively long wave length along the field line. Hybrid diffusion must proceed along a diffusion line whose slope in the particle energy space is defined by $dw_\perp/dw_{||} = n\omega_d/m\omega_b$, where $w_{||}$ and $w_\perp$ are particle energy components in the direction of parallel and perpendicular to magnetic field line, ω_d and ω_b the drift and bounce frequencies, and m and n are integers. The obtained expression of diffusion coefficient is combined with Mozer's power spectrum of random electric field in the magnetosphere. Large transport coefficient is obtained for particle penetration deep into the magnetosphere. Finally, a possibility of nonlinear resonance broadening of interaction and the associated enhancement of diffusion coefficient are briefly examined. (auth)

3319 DISPERSION CHARACTERISTICS OF WHISTLER ATMOSPHERICS DURING HIGHER GEOMAGNETIC ACTIVITY. Ralchovski, T. M. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 7, 875-878(1973).

The behavior of whistler dispersion in periods of geomagnetic disturbances is investigated from October 1970 to June 1971. The whistlers were recorded in the Sofia Observatory. (MHR)

3320 GREENSTADT'S BINARY INDEX CRITERION. Northrop, T. G.; Birmingham, T. J. (Goddard Space Flight Center, Greenbelt, MD). J. Geophys. Res.; 78: No. 13, 2308-2310(1 May 1973).

The Greenstadt-type criterion for distinguishing between laminar and "pulsating" (i.e., irregular) bow shock crossings can be expressed as a critical angle between the shock normal and the magnetic field. When the field is more tangent to the shock plane than this critical angle, the shock is laminar. More importantly, the requirement of Galilean invariance of the physics underlying such a criterion reveals that the Greenstadt p index must vary inversely as the solar wind velocity. (auth)

3321 CORRESPONDENCE OF SOLAR FIELD SECTOR DIRECTION AND POLAR CAP GEOMAGNETIC FIELD CHANGES FOR 1965. Campbell, W. H. (National Oceanic and Atmospheric Administration, Boulder, CO); Matsushita, S. J. Geophys. Res.; 78: No. 13, 2079-2087(1 May 1973).

World Data Center A magnetic tapes containing 2.5-min digitizations of 1965 magnetograms from observatories at Godhavn, Resolute Bay, and Thule were used to determine the daily average residual variation of geomagnetic field after removal of the Sq change and earth's main field contribution to the field. A correlation coefficient of only −0.6 was found between the Thule Z component and the Godhavn H component. If days when the average H residual magnitude at Godhavn was greater than 10 γ were used, the negative values correspond to solar sector fields toward the sun and the positive values corresponded to solar sector fields away from the sun for 61% of the days. By further restricting the data to summer months the agreement rose to 70% of the days. Our own automated method was used to evaluate Svalgaard's visual techniques. (auth)

3322 STATISTICS OF BOW SHOCK NONUNIFORMITY. Greenstadt, E. W. (TRW Systems Group, Redondo Beach, CA). J. Geophys. Res.; 78: No. 13, 2331-2336(1 May 1973).

The statistical occurrence of pulsation or oblique structure around the earth's generally nonuniform bow shock has been estimated at selected points by combining a three-dimensional distribution of interplanetary field directions obtained for a 6-day solar wind sector in 1964 with an index of local pulsation geometry. In a like interval, when a comparable distribution prevails, the shock should exhibit the following characteristics. In the subsolar hemisphere, oblique structure should be expected about 40-60% of the time in the morning and 35-45% of the time in the evening or about 40-50% more often at dawn than at dusk for corresponding points on the ecliptic. The subsolar region of the bow shock should exhibit pulsation structure about 36% of the time. (auth)

3323 GEOMAGNETIC POTENTIAL OF OFFSET DIPOLE COORDINATES. Hilton, H. H.; Schulz, M. (Aerospace Corp., El Segundo, CA). J. Geophys. Res.; 78: No. 13, 2324-2330(1 May 1973).

The geomagnetic potential (IGRF 1965.0) is converted into the spherical coordinates of an optimally offset and inclined dipole by means of a least squares fit to the "transformed" Schmidt coefficients. Time derivatives of the resulting spherical harmonic expansion coefficients are obtained by taking symmetric first difference (1966.0 versus 1964.0). (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstract 4248.

3324 (CONF-730324-, pp 44-46) ION-IMPACT EFFECTS WITH OXIDES. Murti, D. K. 1973.

From ANS Niagara–Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

A review is given of ion sputtering on oxide systems and the resulting significant effects. (JFP)

3325 (COO-3283-7) ELECTRONIC STATES OF B^+ PRODUCED BY ELECTRON BOMBARDMENT OF BORON TRIHALIDES: SOME ION MOLECULE REACTIONS OF B^+. Lin, K. C.; Cotter, R. J.; Koski, W. S. (Johns Hopkins Univ., Baltimore, MD. Dept. of Chemistry). 1972. 12p. Dep. NTIS $3.00.

Beam attenuation studies of B^+ as a function of attenuating gas pressure shows that the beam has a composition of 35% ^3P and 65% ^1S when produced by 70 eV electrons from BF_3. As one proceeds in the series from BF_3 to BI_3, the amount of excited state varies in a regular manner and B^+ ions are completely in the ground state when BI_3 is used as a target. The composition of the beam could also be varied by varying the electron energy. The results of the attenuation studies were also confirmed by studying the cross section vs. beam energy curves for the B^+ (^1S) and B^+ (^3P) reactions with N_2O. (auth)

3326 EXPERIMENTS WITH NUCLEI HEAVIER THAN HYDROGEN ACCELERATED TO SEVERAL GeV. Bartke, J. (Inst. of Nuclear Research, Krakow). Postepy Fiz.; 24: No. 4, 423-435 (1973). (In Polish).

A review is given of the acceleration techniques employed for nuclei heavier than hydrogen. First experiments using such ions in the GeV energy region are described. Possible applications of high energy heavy ions are discussed. (auth)

3327 TROUGHS IN EMISSION LINES OF PRELIMINARILY POLARIZED MOLECULAR (ATOMIC) BEAMS. Bashkin, A. S.; Oraevskii, A. N.; Sakharov, A. E. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 3, 917-925(Sep 1973). (In Russian).

The conditions of appearance of a narrow trough in the center of a homogeneously broadened line are investigated theoretically and experimentally. It is shown that the physical pattern of formation of the trough is different for the cases of single-component and multi-component lines. The method may not only be employed for obtaining narrow lines, but also for resolving the structure of homogeneously broadened lines. (auth)

3328 PARALLEL FLOW OF CYLINDRICAL BEAMS OF CHARGED PARTICLES. Bosi, G. (Départment de Physique, Université de Moncton, Moncton, New Brunswick, Canada). J. Appl. Phys. 44: No. 9, 3990-3992 (Sept 1973).

The usual geometry of an axially symmetric parallel flow Pierce-type gun is criticized and some shortcomings underlined. The general equation defining the family of field forms ensuring parallel flow is carried out and a particular solution selected. The shape of electrodes providing the chosen field form is calculated in a simple reliable way. (auth)

3329 DEPENDENCE OF THE TEMPERATURE BEHAVIOUR OF THE SPUTTERING RATIO ON THE CHANNELLED FRACTION OF THE ION BEAM. Roosendaal, H. E.; Elich, J. J. Ph. (Stichting voor Fundamental Onderzoek der materie, Amsterdam). Radiat. Eff.; 19: No. 2, 127-128(Jun 1973).

In previous papers (Elich et al., Rad. Effects; 10: 175(1971) and 14: 93(1971)) experimental results on the temperature dependence, eventually in combination with angular dependence, of the sputtering ratio were presented. The 20 keV Ar^+ or 20 keV Ne^+ ions were used as bombarding projectiles. The target was monocrystalline Cu. The temperature was varied between 50 and 600°K. The angular dependence combined with temperature dependence was investigated. If $S(\phi,T)$ is the sputtering ratio due to bombardment under an angle ϕ with respect to the surface normal at a temperature T, the experimental results were plotted in the form $S(\phi, T_2) - S(\phi,T_1)/S(\phi, T_1)$ vs the angle ϕ. This relative difference ($\Delta S/S$) is denoted by Q. When changing the angle ϕ away from a low-index direction, Q rises to a maximum for an angle of incidence close to the critical angle and then sharply drops to zero. Measurements presented in the previous paper are reviewed. A curve is shown in which Q is plotted against the random fraction R of the beam immediately at the surface. R is calculated according to Onderdelinden (Appl. Phys. Letters; 8: 189 (1966)). Conclusions are presented. (UK)

3330 CONTRIBUTIONS OF BACKSCATTERED IONS TO SPUTTERING YIELDS DEPENDING ON PRIMARY ION ENERGY. Weissmann, R.; Behrisch, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich, Ger.). Radiat. Eff.; 19: No. 2, 69-75 (Jun 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

Sputtering yields for 33- to 150-keV protons normally incident on Cu-films deposited on different backing materials were measured. The decrease of the Cu-film thickness was determined by Rutherford backscattering. As the base materials used have different backscattering intensities, the contribution to sputtering yield by incident ions and by the ions backscattered to the surface within the material could be separated. It was found that the relative contribution to total sputtering yield by the backscattered ions increases slowly for protons in the energy range from 50 to 150 keV. For energies lower than 50 keV the sputtering yields are determined by the special geometry of the target sandwich used. (auth)

Atomic and Molecular Properties

Refer also to abstracts 3347, 3363, and 4216.

3331 (COO-3242-7) ELEMENTARY RATE CONSTANTS FOR HYDROGEN ATOMS. Annual Progress Report, 1972–73. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA). Dept. of Chemistry). 1 Sep 1973. Contract AT(11-1)-3242. 99p. Dep. NTIS $7.00.

Experimental research on elementary rate constants for hydrogen atoms is summarized. A list of publications is included. (JFP)

3332 SOME PROBLEMS OF QUANTUM MECHANICS POSSESSING A NON NEGATIVE PHASE-SPACE DISTRIBUTION FUNCTION. Kuryshkin, V. V. (Equip de Recherche sur les Fondements de la Physique Quantique, Paris). Int. J. Theor. Phys.; 7: No. 6, 451-466(1973).

In order to clarify physical consequences due to the presence of a set of auxiliary functions $\phi_k(q, t)$ in quantum mechanics with a nonnegative phase-space distribution function, the simplest quantum-mechanical problems are solved. It is shown that $\phi_k(q,t)$ influences the results of a problem. Therefore it is supposed that $\phi_k(q,t)$ reflect some physical reality (subquantum situation), interacting with a mechanical system. In particular the "subquantum situation" determines the minimum coordinate and momentum uncertainties ($(\delta q)^2$ and $(\delta p)^2$) as well as the coordinate distribution of a "fixed" system and the momentum distribution of a 'free" system. These results provide the opportunity to formulate the notion of a stationary homogeneous isotropic "subquantum situation". Supposing that δq and δp are small an attempt is made to develop an approximate method of solutions (quasi-orthodox approximation). Energy spectrum of an electron in a hydrogen atom is found in the second order of this approximation. (auth)

3333 THREE PROBLEMS AND THEIR RELEVANCE. Rajagopal, A. K. (Louisiana State Univ., Baton Rouge). Proc. Indian Acad. Sci., Sci., Sect. A; 78: No. 1, 13-24(Jul 1973).

Three problems are posed and their solutions (ranging from complete to partial) described. They are the hydrogen atom in an intense magnetic field; the thermodynamics of one-dimensional chain of continuous spins in an external magnetic field interacting via Heisenberg interaction; and the pair correlation function in an interacting many electron system. The relevance of these problems and their solutions to various aspects of physics are stressed. (auth)

3334 URANIUM 4f BINDING ENERGIES STUDIED BY X-RAY PHOTOELECTRON SPECTROSCOPY. Chadwick, D. (Central Electricity Research Lab., Leatherhead, Eng.). Chem. Phys. Lett.; 21: No. 2, 291-294(15 Aug 1973).

Uranium 4f binding energies in a range of U(IV) and U(VI) compounds were measured by x-ray photoelectron spectroscopy. (auth)

3335 EXAMPLES OF QUANTISABLE DYNAMICAL SYSTEMS. The Hydrogen Atom and Automorphism Groups. Hurt, N. E. (Univ. of Massachusetts, Amherst). Int. J. Theor. Phys.; 7: No. 6, 423-430(1973).

The regularized energy surface of the n-dimensional hydrogen atom is shown to be naturally the total space of a quantisable dynamical system. The automorphism groups of dynamical systems are studied; and the connected Riemannian dynamical systems with automorphism groups of maximal dimension are classified. Finally, the compact, connected and simply connected quantizable dynamical system with automorphism group of maximal dimension is shown to be the set of independent harmonic oscillators with equal periods. (auth)

3336 PARAMETRIC STUDY OF ISOTOPE SHIFTS IN Ne 1. Keller, J. C. (Centre National de la Recherche Scientifique, Orsay, France). J. Phys., B (London); 6: No. 9, 1771-1778(Sep 1973).

An empirical interpretation of the isotope shifts, similar to that previously done for the $2p^53s$ and $2p^53p$ configurations, is performed for 14 infrared lines ($2p^54p \rightarrow 2p^53d$ and $2p^55s\ [1/2]_1 \rightarrow 2p^54p$) of Ne I. In addition to trivial parameters (i.e., the first order contribution of the specific mass-shift inside $2p^53d$ and an additive constant), term-dependent parameters for $2p^54p$ and J-dependent parameters for $2p^54p$ and $2p^53d$ are introduced. The J-dependent parameter z_{2p} is found to have almost the same value (0.6 mK) in the $2p^53s$, $2p^53p$, $2p^54p$ and $2p^53d$ configurations. The meaning of all the parameters is discussed, taking into account first and second-order contributions of the specific mass-shift and relativistic corrections to the mass-shift. Ab initio evaluations of the parameters, using MCHF (multiconfigurational Hartree–Fock) wave functions, are also reported. (auth)

3337 HYDROGEN ATOM AS A RELATIVISTIC ELEMENTARY PARTICLE. I. The Wave Equation and Mass Formulae. Barut, A. O. (International Centre for Theoretical Physics, Trieste, Italy); Rasmussen, W. J. Phys., B (London); 6: No. 9, 1695-1712 (Sep 1973).

Motivations and steps are discussed to derive and solve a relativistic wave equation for the atom as a whole as though it were a single elementary particle coupled minimally to the external electromagnetic field. The dynamical group SO(4,2) provides the basic framework. The solution of the wave equation and the nonrelativistic reduction of the matrix elements are discussed. (auth)

3338 CORRELATION EFFECTS ON SPECIFIC ISOTOPE SHIFTS. Labarthe, J. J. (Centre National de la Recherche Scientifique, Orsay, France). J. Phys., B (London); 6: No. 9, 1761-1770(Sep 1973).

A practical method of obtaining compact atomic nonrelativistic wave functions adapted to the 2nd order calculation of expectation values of mono- and bi-electronic operators is described. Specific isotope shifts are thus calculated: as a test for the method, in He I 1s2p for which the exact values are known; in Mg I for the virtual transition 3s3p ^1P-^3P. (auth)

3339 MEASUREMENT OF THE NON-LINEAR STARK EFFECT IN HYDROGEN-LIKE He^+, n = 4. Beyer, H. J.; Kleinpoppen, H.; Woolsey, J. M. (Univ. of Stirling, Scotland). J. Phys., B (London); 6: No. 9, 1849-1855(Sep 1973).

Anticrossing signals S-D and S-F in n = 4 of He^+ show a distinct shift with the static electric field applied to induce the signals. This allows investigation of the nonlinear "Stark effect of the fine structure" at electric fields of 50 to a few hundred V cm^{-1}, a region inaccessible to experiment so far. Within the present accuracy the results agree with calculations based on a diagonalization of the energy matrix in crossed magnetic and electric fields. (auth)

3340 EXPERIMENTAL TOTAL PHOTOELECTRIC CROSS SECTIONS. Parthasaradhi, K. (Andhra Univ., Waltair, India). J. Sci. Ind. Res.; 31: No. 9, 470-476(Sep 1972).

The four available methods and analysis of the total atomic photoeffect cross sections of gamma rays in the energy region 10 to 3000 keV were reviewed. Values of the total and the k-shell photoelectric cross sections by the direct and the indirect methods as well as those of the L- and M-shell photoelectric cross sections were tabulated for Cu, Mo, Ag, Pd, Cd, U, W, Au, Pb, etc. The available experimental cross sections were compared with the theoretical values, and it was concluded that the theoretical cross sections reported by Schmickley and Pratt have the highest accuracy among the presently available data; the method of obtaining the shell-wise cross sections by multiplying the total cross section value by the ratio shell to total cross section is not only simple but also gives accurate values and the ratio of total cross section to K-shell cross section at the K-edge in U cannot be 1.235 as reported in literature and is not less than 1.26. Thus, an energy dependence of the ratio is inferred. It was also remarked that the following systematic experimental determinations are necessary to get more accurate information: total photoelectric cross sections at high gamma energies, shell-wise cross sections by direct measurements and values of the total-to-shell ratios. (INIS)

3341 MEASUREMENT OF RELATIVE TRANSITION PROBABILITIES FOR THE ABSORPTION LINES $2^1P \rightarrow n^1D$ AND $2^1P \rightarrow m^1S$ OF He I. Damaschini, R.; Brochard, J. (CNRS, Orsay, France). Opt. Commun.; 9: No. 1, 89-91(Sep 1973). (In French).

An optical absorption method was devised to determine relative transition probabilities for the singlet (2P–nS) and (2P–nD) transitions of He I. The preliminary results are in good agreement with published theoretical values. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 3544 and 3687.

3342 RECENT MEASUREMENTS OF THE HYPERFINE STRUCTURE OF THE MUONIUM. Favart, D. (Univ., Louvain, Belgium). pp 11 of Hyperfine Interactions Detected by Nuclear Radiation. Liege; Univ. Liege (1973). (In French).

From hyperfine interactions detected by nuclear radiation; Liege, Belgium (11 Sep 1973).

The study of muonium and in particular the measurement of the hyperfine structure allows in principle the determination of the value of the fine structure constant α. Several recent experimental results are presented which allow certain incertainties to be raised which are in disagreement with the conclusions of previous measurements. A new experimental method is described which was perfected by the Chicago group (V. L. Telegdi and collaborators) to understand the resonance method of Ramsey by a pulsed radiofrequency field. This method gives the most precise measurement of the hyperfine interval of muonium $\Delta\nu$ = 4463.3045(18) MHz (0.4 ppm). Furthermore, an extension of this method of measurement of the Zeeman transitions in muonium permits one to discount an appreciable improvement in the precision of the determinations of the muon magnetic moment. It is actually the uncertainty in this latter quantity which has an outstanding role in the error in the value of α deduced from the measurements: α^{-1} = 137.03638(18) (1.4 ppm). (tr-auth)

3343 FIZIKA MEDLENNYKH POZITRONOV. (Physics of Slow Positrons). Arifov, U. A.; Arifov, P. U. Moscow; Izdatel'stvo FAN Uzbekskoi SSR (1971). 244p.

The annihilation of positrons in matter, positrons in atomic system, and double-photon angular correlation are discussed. Particular attention is devoted to studying the possibilities of using positron annihilation in the research of such fundamental chemical processes as ionization and excitation of atoms and molecules, reaction kinetics of hydrogenlike atoms in gases and solids, and free radical identification. Some prognostication of further development paths is included. Quantum mechanical methods are used in studying positron atomic systems. 359 references. (SJR)

3344 SELF CONSISTENT DESCRIPTION OF THE NUCLEAR MONOPOLE POLARIZATION IN MUONIC ^{208}Pb. Martorell, J. (Universidad Autonoma, Madrid); Campi, X. Phys. Lett.; 46B: No. 3, 296-298(1 Oct 1973).

The monopole part of the nuclear polarization energy in muonic ^{208}Pb, $1s_{1/2}$ level, is calculated in the Hartree Fock approximation using a number of Skyrme-type forces. The result found, – 0.7 ± 0.2 keV is smaller than previous estimates. (auth)

3345 K-MESIC ATOM. Myhrer, F. Ark. Fys. Seminar Trondheim; No. 5, 9p.(1973).

Assuming that the Y_0^* (1405) resonance dominates the $\bar{K}N$ system at threshold, it is shown in a three-body K^-d model that to get the correct sign of the real part of the kaon-nucleus optical potential, one must use an off-shell $\bar{K}N$ amplitude and that higher $\bar{K}N$ multiple scattering including intermediate nuclear excitations are important. (auth)

3346 PHOTOSTIMULATED QUENCHING AND QUENCHING BY OXYGEN MOLECULES OF TRIPLET POSITRONIUM IN THE SOLID PHASE. Buchikhin, A. P.; Chirkov, V. N.; Shantarovich, V. P. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 3, 175-177(1973).

Translated from Khim. Vys. Energ.; 7: No. 3, 195-198(1973).

The influence of the UV irradiation of cyclohexane and of a solution of diphenylamine (DPA) in benzene at the temperature of liquid nitrogen on the lifetime of triplet positronium ^3Ps was studied. A shortening of the lifetime of ^{3}Ps on the irradiation of these systems permits the conclusion that positronium takes part in a reaction with the photolysis products. An evaluation of the diffusion coefficient of ^{3}Ps performed by means of the Smoluchowski equation gives an anomalously large value ($\sim 10^{-3}$ cm^2/sec). The possible state of ^{3}Ps in the systems studied is discussed, and it is concluded that it is localized in the vacancies present at the boundaries of the domains of the polycrystal, the mobility of the ^{3}Ps being due to its tunneling from one vacancy to another. (auth)

Collision Phenomena

Refer also to abstracts 2797, 4045, and 4062.

3347 (COO-1674-85) BASIC STUDIES OF ATOMIC DYNAMICS. Progress Report, October 1, 1972–September 30, 1973. Fano, U. (Chicago Univ., Ill. (USA)). [nd]. Contract AT(11-1)-1674. 9p. Dep. NTIS $3.00.

Several lines of research, mostly interrelated, were advanced this year. The study of the prototype two-electron program was restarted. Further applications of the quantum defect and frame transformation methods were extensive, analyzing and interrelating spectral and collision parameters of Ar, Xe, Al and of the alkaline earths. A new method for R matrix calculations was developed and tested for Ar. This method is being adapted to a cellular approach to molecular and crystal problems. A list of publications is included. (auth)

3348 (COO-2130-83) ATOMIC AND NUCLEAR RESEARCH WITH ACCELERATORS. Interim Progress Report, 1 October 1972–1 October 1973. (Kansas State Univ., Manhattan (USA). Dept. of Physics). Oct 1973. Contract AT(11-1)-2130. 29p. Dep. NTIS $3.50.

Research on ion-atom collisions and heavy-ion nuclear reactions is summarized. A list of publications is included. (JFP)

3349 (JINR-D6-7094, pp 163-164) STUDY OF THE K X RAYS IN IRRADIATION OF SOLID TARGETS BY XENON IONS WITH ENERGIES OF 150 MeV. Gippner, P.; Kaun, K. G.; Noibert, V.; Stari, F.; Shul'tse, V. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3350 (LBL-1873) DYNAMICS OF NONREACTIVE INELASTIC ION-MOLECULE COLLISIONS. Dimpfl, W. L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1973. Contract W-7405-eng-48. 194p. Dep. NTIS $11.75.

Thesis.

A tandem electrostatic energy analyzer molecular beam apparatus was built for studying low energy inelastic 180° scattering of alkali ions from molecules. A beam of essentially monoenergetic ions is produced by a first analyzer and is focused on the center of a scattering cell containing essentially stationary molecules. Ions which are not significantly deflected in their laboratory motion after collisions with the molecules are energy analyzed with a second analyzer. The scattered beam intensity detected at a particular final laboratory energy is attributable to collisions resulting in a distinct amount of inelasticity. The $Na^+ - H_2$, HD, D_2 scattering was studied in the relative energy range of 0.74 to 30. eV. The $Na^+ - D_2$ system shows predominantly vibrationally elastic scattering below 8 eV relative energy. Above 8 eV the most probable inelasticity observed increases monotonically with the initial collision energy and is comparable to excitation to higher vibrational levels. At 17 eV this inelasticity is 3.92 eV. Classical trajectory calculations are used to study the contribution of different collision orientations to the scattering spectra. It is found that collisions in which the projectile approaches the molecule along the bisector of its bond yield the most significant contribution to the backscattering spectra. It is shown that all backscattering can be accounted for by considering only zero impact parameter collisions. The results of trajectory calculations using a dumbbell repulsive ion molecule interaction potential on collisions restricted to zero impact parameter are fit to the experimental data. Through the discrepancies in the fit it is found that the ratio of the stiffness of the interaction potential along the collinear axis to that in the molecular bisector plane is greater than that ratio for the dumbbell potential. (auth)

3351 (LBL-2212) INTERACTION OF MOLECULAR BEAMS WITH SOLID SURFACES. Somorjai, G. A.; Brumbach, S. B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1973. Contract W-7405-eng-48. 73p. (CONF-730847-1). Dep. NTIS $5.75.

From proceedings of the International Summer Institute in surface science; Milwaukee, Wisconsin, USA (28 Aug 1973).

Molecular beam–surface scattering experiments, the nature of elastic and inelastic scattering, and the information obtained from detection of the angular distribution and kinetic energy of the scattered particles are described. The types of energy exchange that take place between a gas atom or molecule and the surface atoms and the theories that have been developed to explain some of these energy transfer processes are discussed. Finally the results of some experiments are reviewed, and directions for future research are pointed out. (JFP)

3352 (RLO-1388-224) INNER-SHELL IONIZATION BY HEAVY IONS IN THE MeV ENERGY RANGE. Burch, D. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). Aug 1973. 17p. (CONF-730709-5). Dep. NTIS $3.00.

From 8th international conference on the physics of electronic and atomic collisions; Belgrade, Yugoslavia (16 Jul 1973).

A survey is given of recent work on inner-shell ionization by heavy ions with $Z_1 > 4$ at collision energies of 5 to 100 MeV. Current data are from Van de Graaff, cyclotron, and HILAC facilities and include: high resolution x-ray and Auger-electron spectra, vacancy-production cross sections for a wide range of ion-atom systems and energies, the dependence of some of these cross sections on the incident-ion charge state and impact parameter, systematic studies of the multiple ionization which is characteristic of heavy-ion collisions, and measurements of the resultant changes in the fluorescence yields. Ionization mechanisms, united-atom phenomena, and the effects of nuclear Coulomb excitation are discussed. (auth)

3353 CHARGE TRANSFER IN PROTON–HYDROGEN COLLISIONS BY THE FADDEEV APPROACH. Chanduri, J.; Ghosh, A. S.; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). Phys. Rev., A; 7: No. 5, 1544-1548(May 1973).

An approximate form of the Faddeev equations was applied to the charge-transfer process in proton–hydrogen collisions. The effect of coupling with the direct channel was taken into account. This formalism satisfies the unitarity condition below the breakup threshold. Results for the ground-state capture cross section were obtained with and without the inclusion of the effect of proton–proton interactions. The experimental findings for the capture cross section in the energy range 1 to 50 keV lie in between the two sets of results. At high incident energies the results with and without the proton–proton interaction have approached the Jackson–Schiff and Brinkman–Kramers cross sections respectively. The differential cross sections for the capture in the forward direction were compared with the corresponding results of other theorists. Results for the elastic cross section were also obtained. (auth)

3354 COMPUTATION OF THE EFFECTIVE CROSS SECTION OF THALLIUM ATOM COLLISIONS. Abashev, Yu. G.; Voronin, G. F.; Valitov, R. A. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 2, 254-255(Feb 1973).

Translated from Izmer. Tekh.; 16: No. 2, 60-61(Feb 1973).

The experimental data on the distribution of velocities in molecular beams is used for computing the effective cross section of collisions for thallium atoms. (JFP)

3355 TIME DECAY OF ION BOMBARDMENT INDUCED PHOTON EMISSION. Martel, J. G.; Olson, N. T. (Massachusetts Inst. of Tech., Cambridge). Radiat. Eff.; 19: No. 1, 19-21(May 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

Spectral line emission from sodium ion bombardment of aluminum polycrystalline targets was observed to be dependent upon the target ion bombardment dose. Al and Na emission levels from an unbombarded target decay with ion dose to a saturation level. Qualitative calculations show that the photon emission decay time is consistent with implanted ion saturation times. Cesium ion bombardment, because of its shorter range and smaller saturation time, did not yield any transient results. (auth)

3356 ESTIMATION OF ELECTRON POTENTIAL EMISSION YIELD DEPENDENCE ON METAL AND ION PARAMETERS. Kishinevsky, L. M. (Inst. of Electronics, Tashkent). Radiat. Eff.; 19: No. 1, 23-27(May 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

The dependence of γ –the coefficient of potential emission of electrons from metals on the work function ϕ and Fermi energy ϵ_F for metals and the ionization energy of ions E_i is discussed. It was found that $\gamma \approx (0.2/F\ (0.8\ E_i - 2\ \phi)$ in the range $3\ \phi < E_i <$

$2(\epsilon_F + \phi)$. Deviations from this dependence exceeding 10% were observed at $E_1 < 3\,\phi$ and at $E_1 > 2(\epsilon_F + \phi)$. Theoretical estimates are in satisfactory agreement with experimental results. (auth)

3357 PERTURBATION THEORY WITH ALLOWANCE FOR EXCHANGE FORCES. Rumyantsev, A. A. (Leningrad Polytechnic Inst.). Zh. Eksp. Teor. Fiz.; 65: No. 3, 926-932(Sep 1973). (In Russian).

Perturbation theory applicable to interatomic interactions with allowance for exchange forces is formulated which does not require an initial orthogonal function basis. The theory is employed for determination of the interatomic forces and of the hyperfine structure spectral line shift in a hydrogen-helium atomic mixture. (auth)

3358 SIMULTANEOUS VIBRATIONAL AND ROTATIONAL TRANSITIONS IN HYDROGEN + ARGON AT HIGH COLLISION VELOCITIES: COLLISIONS AT NONZERO IMPACT PARAMETERS. Young, A. W.; Shin, H. K. (Univ. of Nevada, Reno). Chem. Phys. Lett.; 21: No. 2, 267-270(15 Aug 1973).

The problem of vibrationally and rotationally inelastic scattering processes in H_2 + Ar for nonzero impact parameter b was investigated in the collision velocity range of 10^6 to 10^7 cm/sec by use of the sudden approximation. The simultaneous vibrational (0 → 1) and rotational (00 → 00, 20, or 40) transitions were studied. For $v > 3 \times 10^6$ cm/sec, the probabilities for $b/l = 1.0$ are found to be very large compared with those for $b = 0$, where l is the hard-sphere collision diameter; for $b/l > 1.0$, the probabilities decrease very rapidly with increasing b. The results show that nonzero-b collisions must be included in the calculation of simultaneous transition processes in H_2 + Ar at higher collision velocities. (auth)

3359 ELECTRON AFFINITIES OF ATOMS AND MOLECULES FROM COLLISIONAL ELECTRON DETACHMENT RATES IN NONTHERMAL FIELDS WITH AN APPLICATION TO O^-. Rebentrost, F. (Univ., Munich). Chem. Phys. Lett.; 21: No. 2, 368-372 (15 Aug 1973).

A method to determine electron affinities from endothermic electron detachment rates in nonthermal electrical fields is described. Special reference is made to the reaction $O^- + O_2 \rightarrow O + O_2 + e$. A recently defined temperature scale $[T_1 = (m/m + M)\,T_g + (Me/m + M^k{}_B\sigma_g)/(E/N)]$ is also applicable. (auth)

3360 CROSS SECTION FOR THE REACTION $Ne + e \rightarrow Ne^+ + 2e$. Narain, U.; Jain, N. K. (Meerut Coll., India). Phys. Lett.; 45A: No. 3, 233(24 Sep 1973).

Ionization cross section of Ne by electron impact has been calculated using a semi-empirical approach in the energy range 100–20,000 eV. The results are in good agreement with the available experimental data. (auth)

3361 CURRENT TRENDS IN ION SCATTERING FROM SOLID SURFACES. Mashkova, E. S.; Molchanov, V. A. (Moscow State Univ.). Radiat. Eff.; 19: No. 1, 29-37(May 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

Several current trends in the study of ion scattering from solid surfaces are discussed, especially in respect to the conditions necessary for reproducible measurements and to interpretation of the experimental results. (auth)

3362 USE OF SECOND ORDER POTENTIALS IN THE THEORY OF SCATTERING OF CHARGED PARTICLES BY ATOMS. VI. Elastic Scattering of Electrons by Hydrogen and Helium Atoms. Winters, K. H.; Clark, C. D.; Bransden, B. H.; Coleman, J. P. (Univ. of Durham, Eng.). J. Phys., B (London); 6: No. 9, L247-L249(Sep 1973).

Angular distributions for the elastic scattering of electrons by hydrogen and helium atoms were calculated by the second order potential method of Bransden and Coleman (J. Phys. B. Atom. Molec. Phys.; 5: 537-45 (1972)), using a partial wave expansion and allowing for exchange, in the energy interval 50 to 200 eV. Good agreement with experimental data is obtained except at large angle scattering, for which the calculated values are up to 25% smaller than those measured. (auth)

3363 DISSOCIATION OF $CH_nD_{4-n}^+$ ($n \leq 4$) IONS DURING COLLISIONS WITH RARE-GAS ATOMS. Constantin, E. (Faculte de Physique, Cluj); Abbe, J. C. J. Phys., B (London); 6: No. 9, L272-L274(Sep 1973). (In French).

Dissociation of CH_4^+, CH_3D^+, $CH_2D_2^+$, CH_3H^+ and CD_4^+ ions with energies between 2 and 25 eV during collisions with atoms of He, Ne, Ar, Kr and Xe was studied with a two-stage longitudinal type mass spectrometer. The nature of the secondary ions and the H-D isotopic shift of CX_3^+ (X = H,D) ions as a function of energy were studied. (tr-auth)

3364 NONADIABATIC MECHANISM OF THE VIBRATIONAL RELAXATION OF NO MOLECULES ON COLLISION WITH Ar ATOMS. Zembekov, A. A.; Umanskii, S. Ya. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 164-165(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 184-185(1973).

The probability P_{10} of the vibrational deactivation of NO molecules in collisions with Ar atoms, which was measured experimentally in the temperature range of 1000 to 2000°K, is calculated. The calculation of P_{10} is performed in two stages. First, the adiabatic electronic–vibrational terms of the system are determined. Then the probabilities of transition between the intersecting terms are calculated by the Landau–Ziner formula. (JFP)

3365 DISSOCIATION OF N_3^+ IONS DURING COLLISIONS WITH N_2 IN THE KINETIC ENERGY RANGE UP TO 100 eV. Zhurkin, E. S.; Tikhomirov, M. V.; Tunitskii, N. N. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 90-91(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 101-103(1973).

The transverse cross sections for the dissociation of N_3^+ ions in the process $N_3^+ + N_2 \rightarrow N^+ + (2N_2)$ were measured on a double mass spectrometer in the kinetic energy range ≤100 eV. It was shown that the excitation energy of the N_3^+ ions depends on the energy of the ionizing electrons with which the initial N_2^+ ions, which participate in the ion–molecular reaction for the formation of N_3^+, were obtained and the energy for rupturing the $N^+–N_2$ bond in the most excited N_3^+ ions is ~0.4 eV. (auth)

3366 DISSOCIATION OF CO^+ AND N_2^+ IONS OF DIFFERENT ORIGIN DURING COLLISIONS WITH Ne AND N_2 AT COLLISION ENERGIES OF UP TO 100 eV. Zhurkin, E. S.; Tikhomirov, M. V. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 92-95(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 103-108(1973).

The absolute dissociation cross sections (σ) for CO^+ ions obtained from the electron impact of CO and CO_2 on Ne and N_2^+ ions obtained from N_2 and N_3H on N_2 and Ne were measured using a double mass spectrometer at energies of ≤100 eV. It was concluded, from the dependence of σ for the CO^+ ions from CO_2 in the prethreshold impact energy range, that they have an excitation energy close to 8.4 eV; the CO^+ ions from CO are almost unexcited. The fragment ions N_2^+ from N_3H have some excess excitation as compared with molecular ions. (auth)

3367 TRANSLATIONAL ENERGY SPECTRUM OF O_2 IONS FORMED BY 4 keV O_2^+ IONS IMPACTING ON ARGON. Fehsenfeld, F. C.; Appell, J.; Fournier, P.; Durup, J. (Paris Univ., Orsay, France). J. Phys., B (London); 6: No. 9, L268-L271(Sep 1973).

The translational energy spectrum of O_2^- arising from single and double collision double charge transfer between 4-keV O_2^+ ions and Ar atoms was recorded. The incident O_2^+ ions are found to be either in the ground $\tilde{x}^2\Pi_g$ state or in the metastable $\tilde{a}^4\Pi_u$ state. The single-collision double charge transfer is observed only from metastable O_2^+ ions, ground state O_2^+ leading to autodetaching levels of O_2^-. This result gives evidence on the validity of Franck-Condon principle for molecular transitions occurring in double charge transfer processes. (auth)

3368 ELASTIC AND 2s, 2p EXCITATION CROSS SECTIONS OF HYDROGEN ATOM BY THE FADDEEV APPROACH. Saha, B. C.; Ghosh, A. S.; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). J. Phys., B (London); 6: No. 9, L252-L254(Sep 1973).

A tractable form of the Faddeev equations was applied to the e^--H collision problem including the effects of the couplings of 1s, 2s and 2p states. Numerical results were presented for the elastic and 2s, 2p excitation cross sections at an incident energy 13.6 eV neglecting the exchange effects. (auth)

3369 INELASTIC ELECTRON–HELIUM SCATTERING AT LARGE ANGLES. Nicholls, P. S.; Winters, K. H. (Univ. of Durham, Eng.). J. Phys., B (London); 6: No. 9, L250-L251 (Sep 1973).

Excitation cross sections for electron–helium scattering were calculated by the method of Bransden and Coleman (J. Phys. B. Atom. Molec. Phys.; 5: 537-45 (1972)) in an impact parameter approximation. Results are presented for 2^1S and 2^1P excitation at angles greater than 20°. (auth)

3370 ION SPECTRA FROM SLOW COLLISIONS OF He^+ WITH He, Ne, Ar, AND OF Ne^+ WITH Ne. Gerber, G.; Niehaus, A.; Steffan, B. (Univ., Freiburg i. B.). J. Phys., B (London); 6: No. 9, 1836-1848(Sep 1973).

An ion spectrometer is described, which allows the doubly differential analysis of all ions emerging from the scattering center of a projectile ion beam and a thermal target gas beam. The transition of the spectrometer is high enough as to make possible also the analysis of multiply charged ions formed by ionization of the projectile, as well as of singly and multiply charged recoil-ions formed from the target gas. The energy resolution obtained is $\Delta E/E = 5\ ^{0}/_{00}$. For collisions of He^+ with He, Ne, Ar, and of Ne^+ with Ne, at 1 keV collision energy and a detection angle of $\Theta = 8°$ (with respect to the projectile beam direction) total ion spectra are shown, and most probable energy losses—corresponding to peaks or structures of the ion spectra—are given and discussed. It is found that all dominant excitations and ionizations of the final collision system can be explained by initial excitation of one or two electrons of the outer shell of the molecule formed during collision, where one- and two-electron excitations are of the same order of importance. This result is in qualitative agreement with predictions of the Fano–Lichten electron promotion model for outer shell excitations. In the case of the He^+/Ar collision system the ion spectrum shows that charge exchange processes leading to neutral He-atoms dominate the elastic and inelastic scattering of He^+. (auth)

3371 CALCIUM K X-RAY SPECTRA PRODUCED BY OXYGEN, ALPHA-PARTICLE, AND PROTON BOMBARDMENT. McWherter, J.; Bolger, J.; Moore, C. F.; Richard, P. (Univ. of Texas, Austin). Z. Phys.; 263: No. 4, 283-290(1973).

$K\alpha$ and $K\beta$ X-rays of calcium were produced by bombarding a thick calcium wafer with oxygen, helium and hydrogen ions. These reactions produce a substantial amount of inner shell ionization. The K x-ray spectra contain x-ray lines from calcium which emanate from initial states with a varying degree of K or L shell vacancies. The initial configurations were assigned on the basis of Hartree–Fock–Slater calculated energies. Related intensity ratios of $1s \rightarrow 2p$ ($K\alpha$) transitions and of $1s \rightarrow 3p$ ($K\beta$) transitions of H plus Ca, He plus Ca and O plus Ca were obtained. In addition to observing many new transitions due to multiple K and/or multiple L shell vacancies, energy shifts relative to the H plus Ca spectrum were observed in the O plus Ca spectrum due to M shell vacancies. (GE)

3372 USEFUL APPROXIMATION AND SIMPLE SCALING LAWS FOR PREDICTING ION–DIPOLE CAPTURE CROSS SECTIONS AND RATE COEFFICIENTS. Dugan, J. V. Jr. (Lewis Research Center, Cleveland). Chem. Phys. Lett.; 21: No. 3, 476-482(1 Sep 1973).

A useful analytical approximation for ion–dipole capture cross sections is reviewed and used to obtain capture coefficients. Numerical scaling laws for obtaining cross sections from new numerical data are outlined. The results are compared with the predictions of Su and Bowers which are in good agreement with experiment even though certain of their assumptions are in conflict with numerical trajectory results. (auth)

3373 NEGATIVE SURFACE IONIZATION OF HYPERTHERMAL HALOGEN ATOMS. Koennen, G. P.; Grosser, J.; Haring, A.; DeVries, A. E. (FOM-Instituut voor Atoom-en Molecuulfysica, Amsterdam). Chem. Phys. Lett.; 21: No. 3, 445-447(1 Sep 1973).

Negative surface ionization of hyperthermal halogen atoms was studied as a function of their kinetic energy on thoriated tungsten and on niobium wires. The transition from a thermal equilibrium process to direct reflection causes the ionization to increase drastically above thermal energies: efficiencies up to 40% were found for 30 eV Cl atoms impinging on thoriated tungsten. (auth)

3374 HYDROGEN ATOM AS A RELATIVISTIC ELEMENTARY PARTICLE. II. Relativistic Scattering Problems and Photo-Effect. Barut, A. O. (International Centre for Theoretical Physics, Trieste, Italy); Rasmussen, W. J. Phys., B (London); 6: No. 9, 1713-1740(Sep 1973).

The framework developed previously (Barut and Rasmussen. J. Phys. B. Atom. Molec. Phys.; 6: 1695-1712 (1973)) is applied to scattering problems. Relativistic continuum–continuum transitions are calculated as an overlap of scattering states by group-theoretical techniques. Relativistic bound continuum transitions (photoeffect) are calculated by the same methods and nonrelativistic reductions are derived. (auth)

3375 EFFECT OF THE ELECTRON BOUND STATE STRUCTURE ON IONIZATION CROSS SECTIONS IN ATOMIC COLLISIONS. Nikolaev, V. S.; Senashenko, V. S.; Shafer, V. Y. (Moscow State Univ.). J. Phys., B (London); 6: No. 9, 1779-1787(Sep 1973).

The cross sections for loss of 1s-, 2s- and 2p-electrons by various hydrogen-like ions during their encounters with H and He atoms and atomic nuclei were calculated in the Born approximation with the use of the sum rule and compared with each other. The dependence of these cross sections on the structure of the wave functions of the electron bound state is investigated. Comparison is made between theory and experiment. (auth)

3376 EVALUATION OF EXCHANGE MATRIX ELEMENTS IN p–H COLLISION. Tai, H. (City Coll., New York). J. Phys., B (London); 6: No. 9, 1797-1800(Sep 1973).

The method for solving the one-electron exchange integral in the p-H collision which was suggested by Cheshire (Proc. Phys. Soc.; 92: 862-5 (1967)) is extended and modified in a straightforward way. (auth)

3377 DISPERSION MODEL OF A SINGLE-VORTEX FUNCTION OF STRUCTURAL SCATTERING OF ATOMS BY SURFACES. Barantsev, R. G. Vestn. Leningrad. Univ., Mat., Mekh., Astron.; 77-85(Apr 1973). (In Russian).

A model in the form of a Gaussian function with one maximum is proposed for the scattering of atoms by the structural (nonthermal) properties of a solid surface. The model is constructed as a function of the velocity, direction of departure, and angle of incidence. A distinctive feature is the introduction of small parameters, which permits the use of asymptotic methods. Asymptotic formulas for the coefficients of momentum and energy exchange are obtained in series form. (IAA)

3378 SOME FORMAL RESULTS IN THE QUANTUM THEORY OF MOLECULAR SCATTERING. Snider, N. S. (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys.; 59: No. 2, 832-835 (15 Jul 1973).

The two-potential formula for the transition matrix was employed to generalize some results in the formal theory of molecular scattering which were previously derived from R-matrix theory. Most important, the quantum mechanical analog of Wigner's classical expression for an upper bound to the rate constant of a chemical reaction was generalized to apply to a reaction with any number of product molecules. In addition to removing the restriction inherent in R-matrix theory, that only two entities emerge from the collision, the generalized results are free of difficulties connected with choices, necessary in R-matrix theory, of internal and external regions, boundary conditions, and external wave functions. (auth)

Atomic Theory

Refer also to abstracts 4402 and 4421.

3379 COMPUTER GENERATION OF FEYNMAN DIAGRAMS FOR PERTURBATION THEORY. II. Program Description. Wong, H. C.; Paldus, J. (Univ. of Waterloo, Ont.). Comput. Phys. Commun.; 6: No. 1, 9-16(Jul 1973).

The program P. T. DIAGRAM GENERATION written in FORTRAN IV for the S 360/75 computer is described for finding pertinent topologically distinct diagrams of the Hugenholtz type, which are necessary in calculations of correlation energies, ionization potentials, and electron affinities, excitation energies, and double ionization processes using the field theoretical form of the perturbation theory. (JFP)

3380 COMPUTATION OF S-STATE BINDING ENERGY AND WAVE FUNCTIONS IN A SAXON–WOODS POTENTIAL. Cugnon, J. (Univ., Liege). Comput. Phys. Commun.; 6: No. 1, 17-23(Jul 1973).

The program BSSW written in FORTRAN IV for the IBM 370/155 is described for computing the energy and wave function of the s-state in a Saxon–Woods potential. It can also determine the well depth or radius which fits a given binding energy. (JFP)

3381 TERM INTERSECTION IN MULTIPARTICLE INTERACTIONS. Lisitsa, V. S. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 3, 879-885(Sep 1973). (In Russian).

The transition probability in a two-level system ("atom") in the presence of a term intersection point (Landau case) is considered when the intersection is due to interaction between the atom and ensemble of many particles. An expression for the transition probability is obtained which extends the Landau result to the case of multiparticle interaction. Concrete calculations are carried out for monopole-dipole and dipole-dipole interactions when the transition is induced by rotation of the perturbing field. In both cases the transition probability can be expressed in terms of functions describing fluctuations of the perturbing particle field and is essentially nonbinary. For low densities the result is identical to that of the binary calculations, and for high densities it tends to a constant which in general is independent of the density and corresponds to the case of complete "mixing" of the atomic terms. (auth)

3382 ASIMPTOTICHESKIE METODY V TEORII ATOMNYKH STOLKNOVENII. (Asymptotic Methods in the Theory of Atomic Collisions). Smirnov, B. M. Moscow; Atomizdat (1973). 296p.

The book consists of two parts. The first part deals with the

interaction potentials of atomic particle at large distances between the particles. The cases under discussion include the following: the exchange interaction of a single-electron atom and an ion with a filled electron shell, the taking into account of the spin state of atomic residues and the effect of the fine splitting of levels on the magnitude of the exchange interaction potential of an ion with an atom, exchange interaction of an ion and an atom with an unfilled electron shell, asymptotic behavior of the atomic wave function, exchange interaction of a doubly-charged ion with an atom, exchange interaction of a negative ion with an atom, and the exchange interaction of a molecular ion with a molecule. The cases of exchange interactions between atoms include the following: exchange interaction of an atom in the ground state with an atom in the excited state, exchange interactions of ions which correspond to ionic binding and that corresponding to covalent binding, exchange interaction of two atoms with unfilled electron shells, exchange interaction of the same kind of atoms in different states, and the exchange interaction of three atoms. The far interaction of atomic particles deals with the following: the far interaction of an ion with an atom and of two atoms, the interaction potential of atomic particles at far distances, the interaction of an ion and an atom at far distances, the behavior of molecular terms in the presence of spin-orbital interaction, and the interaction of a negative ion with an atom. The second part of the book deals with the collision processes of atomic particles, and includes the following subjects: resonance charge transfer of an ion in an atom, nonresonance charge transfer of an ion in an atom, resonance processes of atomic collision which include spin exchange and transfer between hyperfine structure states, transfer of excitation on collisions between the same atoms, and depolarization of an excited atom as a result of collision with gas atoms, and nonresonance processes of atomic collisions which include nonresonance transfer of excitation with colliding atoms, transfers between components of the fine structure of atoms, and the deactivation of the metastable state of an atom during collisions. The book contains 44 figures, 58 tables and 857 bibliographic citations. (SJR)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

3383 TOROIDAL MAGNETOHYDRODYNAMIC EQUILIBRIUM WITH TOROIDAL FLOW. Strauss, H.R. (Center for Plasma Physics and Thermonuclear Research, Department of Physics, The University of Texas at Austin, Austin, Texas 78712). Phys. Fluids 16: No. 8, 1377(Aug 1973).

Toroidal, axisymmetric, ideal magnetohydrodynamic equilibrium with toroidal flow is examined. (auth)

3384 SUFFICIENT CONDITION FOR MAGNETOHYDRODYNAMIC STABILITY AGAINST AXIALLY SYMMETRIC PERTURBATIONS. Dobrott, D.; Chu, M.S. (Gulf General Atomic Company, San Diego, California 92112). Phys. Fluids 16: No. 8, 1371-1372 (Aug 1973).

A less stringent sufficient condition than that previously given is obtained for magnetohydrodynamic stability against arbitrary fluid displacements which vary in the cross-sectional plane of an axially symmetric equilibrium. An example illustrates the use of the new condition. (auth)

3385 EXPERIMENTAL INVESTIGATION OF A MAGNETICALLY DRIVEN ROTATING LIQUID-METAL FLOW. Robinson, T. (Aktiebolaget Atomenergi, Studsvik, Sweden). J. Fluid Mech.; 60: No. 4, 641-664(9 Oct 1973).

Flow and turbulence in a 50-Hz rotating-field MHD system are investigated using the hot-film constant-temperature anemometer. Factors affecting anemometer disturbances and response time are discussed. From measurements of the magnetic field at points within the liquid, the distribution of MHD forces is estimated. The mean rotational velocity of the flow is of the expected order of magnitude but much less dependent on the axial coordinate than the corresponding MHD force. With the aid of a thermal transit-time anemometer, a weak secondary flow is detected. A note on scale-model studies of MHD systems envisaged in metallurgical applications of magnetohydrodynamics points out some basic difficulties in modeling large high-powered systems on a small scale. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 3190 and 3454.

3386 (RL-73-81) ECONOMICAL FUNCTION FITTING FOR MOMENTUM DETERMINATION. O'Connell, M. J. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Aug 1973. 39p. Dep. NTIS (U. S. Sales Only) $4.00.

Two computer programs LINCOM and GSFIT are described which can be used together to find momenta from spark chamber trajectories. To begin with, a representative sample of trajectories with known momenta is generated by conventional means. Then program LINCOM finds the significant linear combinations of the observed space coordinates, i.e., it performs a factor-analysis. A small number, e.g., 5 or 6, of the more significant linear combinations is passed on to the second program GSFIT. The less significant combinations are available for pattern recognition. Program GSFIT performs a least squares fit to the momenta using functions of the Chebyshev, Legendre or simple monomial type. The arguments of these functions are the more significant linear combinations mentioned above. Because "modified" Gram–Schmid transformations are used to provide an orthogonal set of basis vectors, the user has various controls over the terms which are included in the expansion. In practice, marginally contributing terms can be excluded as the fitting is in progress. Finally a function subprogram is generated for calculating the expected momenta of new trajectories. (auth)

Electromagnetic

Refer also to abstract 3181.

3387 RESULTS OF AN EXPERIMENT TO TEST FOR AN I = 2 TERM IN THE ELECTROMAGNETIC CURRENT. Di Capua, E. (Univ., Rome); Pocci, V.; Severi, M.; Tau, L.; Fiorentino, E.; Palmonari, F.; Reale, A.; Satta, L.; Ubaldini, G. Lett. Nuovo Cim.; 8: No. 11, 692-696(10 Nov 1973).

The ratio r between the differential cross sections of the reactions $\gamma + d \rightarrow \pi^0 + n + ps$ and $\gamma + d \rightarrow \pi^0 + p + n_s$ was measured at 270 to 370 MeV, and at an angle in the center of mass of the pion-nucleon system $\theta_\pi \sim 115°$. The results show that r is ≈ 1, thus giving evidence against the presence of a large isotensor term. (LBS)

3388 SOME EXPERIMENTAL EVIDENCE OF VIRTUAL COMPTON SCATTERING OBTAINED AT 990-MeV WITH THE ORSAY STORAGE RING. Cosme, G.; Jean-Marie, B.; Jullian, S.; Laplanche, F.; Parrour, G.; Szklarz, G. (Univ. Paris Sud, Orsay, France). Lett. Nuovo Cim.; 8: No. 8, 509-512(20 Oct 1973).

Evidence is obtained for e-γ events coming from the $e^+e^- \rightarrow e^+e^-\gamma$ reaction in a particular kinematics where the cross section is well explained by a Williams-Weizsacker-type calculation for a quasi-real photon Compton scattering. It is suggested that such a reaction can provide a good test of QED in the timelike region at higher energies. (LBS)

3389 MEASUREMENT OF ρ^0 AND ϕ-MESON ELECTROPRODUCTION. Dakin, J.T.; Feldman, G.J.; Lakin, W.L.; Martin, F.; Perl, M.L.; Petraske, E.W.; Toner, W.T. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8: No. 3, 687-697 (1 Aug 1973).

We report measurements of ρ^o and ϕ electroproduction at 19.5 GeV in a wide-aperture spectrometer which detected the scattered electron and the decay products of the vector mesons. Data are presented for the region of virtual-photon mass squared $q^2 = -0.25$ to -2.0 $(\mathrm{GeV}/c)^2$ and virtual-photoproduction center-of-mass energy squared s = 10 to 30 GeV². As $|q^2|$ increases, the ρ mass spectrum shape changes and the momentum-transfer distribution broadens. The ratio of the ρ cross section to the total cross section decreases from 11% at $q^2 = 0$ to about 6% at $|q^2| = m_\rho^2$. The ratio for the production of longitudinally to transversely polarized ρ^0 mesons is $0.45^{+0.15}_{-0.10}$ at $|q^2| = m_\rho^2$, and the interference between longitudinal and transverse amplitudes is almost maximal. The relative ϕ-meson cross section also decreases as $|q^2|$ increases. Unitary lower bounds on the longitudinal–transverse ratio in inelastic electron scattering are derived. (auth)

3390 LARGE-ANGLE QUASIELASTIC ELECTRON–DEUTERON SCATTERING. Hanson, K.M.; Dunning, J.R. Jr.; Goitein, M.; Kirk, T.; Price, L.E.; Wilson, R. (Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 8: No. 3, 753-778 (1 Aug 1973).

Measurements of differential cross sections for quasielastic electron–deuteron scattering $e + d \rightarrow e + p + n$ have been made in which recoil protons were detected in coincidence with the scattered electrons. The ratios of the elastic electron–neutron to the electron–proton scattering cross sections are derived from the proton coincidence data. For comparison, these ratios are also determined from the scattered–electron momentum spectra using the peak and area methods. The theory developed by Renard, Tran Thanh Van, and LeBellac, which includes corrections for the final–state interactions, is found to explain the proton coincidence results. The present measurements, made at an electron scattering angle of 90 ° for four–momentum transfers of $q^2 = 7, 10, 15$, and 29 F^{-2}, and at 80 ° for $q^2 = 45\ F^{-2}$, are combined with previous results to obtain the electromagnetic form factors of the neutron. (auth)

3391 STUDY OF π^- INCLUSIVE PRODUCTION IN γD INTERACTIONS WITH A 7.5–GEV LINEARLY POLARIZED PHOTON BEAM. Alexander, G.; Benary, O.; Dagan, S.; Gandsman, J.; Grunhaus, J.; Katz, P.; Levy, A.; Lissauer, D.A. (Department of Physics and Astronomy, Tel Aviv University, Israel). Phys. Rev. D 8: No. 3, 712-719 (1 Aug 1973).

The reaction $\gamma d \rightarrow \pi^- +$ anything at 7.5 GeV with a linearly polarized photon beam has been studied. The γn average charge multiplicity was found to be a unit charge less than the γp average charge multiplicity. We have extracted information on the inclusive π^- production in γn reactions using the γp inclusive data. The ratio of π^+ to π^- inclusive production in the target fragmentation region was found to be independent of the beam. Two–particle correlations in both x and y variables are presented. (auth)

3392 UNEXPLAINED MULTIPHOTON PHENOMENON. Collins, G.B.; Ficenec, J.R.; Stevens, D.M.; Trower, W.P. (Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061); Fischer, J. Phys. Rev. D 8: No. 3, 982-983 (1 Aug 1973).

In 1954 Schein, Haskin, and Glasser reported a cosmic-ray event consisting solely of at least sixteen highly collimated photons. Here we compare this event and four other similar ones reported in the literature. These five events show remarkably similar characteristics and the possibility of them all being fortuitous occurences is essentially precluded. Their characteristics also make it unlikely that the photons originate from electromagnetic showers or multiply produced π^0 mesons. Some unexplained phenomenon seems indicated. (auth)

3393 STUDY OF THE INTERACTION BETWEEN NEUTRONS AND ELECTRONS IN THE JINR PULSED FAST REACTOR. Aleksandrov, Yu. A.; Balagurov, A. M.; Vasilenko, L. I.; Machekhina, T. A.; Samosvat, G. S. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 108-112 of Neitronnaya fizika. Chast, I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The intensities of Bragg reflections from single crystals of tungsten enriched in the ^{186}W isotope were measured by the time-of-flight method. The isotopic composition of the samples was such that their total coherent scattering amplitudes were of different signs. Information on the constants of neutron–electron interaction was obtained. The perspectives of future research on this line are considered. (1 figure) (auth)

Weak

3394 (JINR-P15-7202) CONNECTION OF THE MESIC X-RAY SPECTRUM STRUCTURE WITH NEGATIVE MUON DEPOLARIZATION. Arl't, R.; Evseev, V. S.; Ortlepp, G. Kh.; Roganov, V. S.; Sabirov, B. M.; Khaupt, Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 10p. (In Russian). (CONF-730642-12). Dep. NTIS (U. S. Sales Only) $3.00.

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Depolarization (P_μ) of negative muons is measured by the muon spin precession method in the transverse magnetic field in coincidence with separate lines of K-series of mesic X-ray radiation of C mesic atom in graphite and paraffin. The character of dependences of P_μ on the mesic atom transition energy in the studied matters is identical. The course of dependence of P_μ on n for the transitions from levels, having n ≤ 4, does not contradict the conclusions of cascade depolarization theory. (auth)

3395 (RL-73-85) TEST OF THE $\Delta S = \Delta Q$ RULE IN K_{e3} DECAY. Hart, J. C.; Hutton, J. S.; Field, J. H.; Sharp, P. H.; Blackmore, E. W. A.; Fisk, H. E.; Manning, G.; Parham, A. G.; Reading, D. H.; Salter, D. C.; Tapper, R. J. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). 1973. 62p. Dep. NTIS (U. S. Sales Only) $5.25.

An optical spark chamber experiment was performed to test the $\Delta S = \Delta Q$ rule in the decay $K^0 \to \pi^\pm e^\mp \nu$. Neutral kaons of initial strangeness $S = +1$ were produced via the reaction $\pi^- p \to \Delta K^0$. The result obtained was Re $x = -0.03 \pm 0.07$, Im $x = 0.09 \pm 0.07$, which is consistent with no violation of the $\Delta S = \Delta Q$ rule. (auth)

3396 NEW DETERMINATION OF THE DALITZ-PLOT DISTRIBUTION FOR τ^- DECAYS. Lucas, P.W.; Taft, H.D.; Willis, W.J. (Yale University, New Haven, Connecticut 06520). Phys. Rev. D 8: No. 3, 719-727 (1 Aug 1973).

We have measured the X and Y projections of the Dalitz plot of 81000 τ^- decays. The decays were observed in a beam of 400-MeV/c K^-'s in the BNL 30-in. liquid-hydrogen bubble chamber. For the X distribution we find no deviation from phase space. For Y we find a distribution of (phase space) × $(1 + AY)$ and have determined for A the values 0.252 ± 0.011 with Coloumb corrections to the distribution, 0.219 ± 0.008 without Coulomb corrections. The results have been obtained using a method which involves measured rather than fitted quantities. (auth)

3397 STUDY OF K^--MESON DECAY PROPERTIES USING DALITZ PAIRS FOR π^0 DETECTION. Lucas, P.W.; Taft, H.D.; Willis, W.J. (Physics Department, Yale University, New Haven, Connecticut 06520). Phys. Rev. D 8: No. 3, 727-738 (1 Aug 1973).

A sample of about 5000 K^- decays in flight, each accompanied by a Dalitz pair, has been observed in a hydrogen bubble chamber. These events consist of 3564 ± (3.1%) $K_{\pi 2}$ events, 786 ± (4.6%) K_{e3} events, 554 ± (7.6%) $K_{\mu 3}$ events, and 574 ± (5.9%) τ events. Ratios among these numbers give results in agreement with accepted K^+ branching ratios. The separation of the events has involved a sophisticated Monte Carlo program, ionization, kinematics of the K^- decay, and kinematics of the Dalitz decay. The π^- energy spectrum of the τ decays may be written as: (phase space) × $[1 + (2A/M_\pi^2)(s_3 - s_0)]$, where s_i is the square of the 4-momentum transfer to particle i, $s_0 = (1/3)(s_1 + s_2 + s_3)$, and A is a slope to be determined. We find $A = 0.242 \pm 0.042$. (auth)

3398 TESTING THE ADLER AND GROSS-LLEWELLYN SMITH SUM RULES IN HIGH-ENERGY NEUTRINO REACTIONS. Cline, D. (University of Wisconsin, Madison, Wisconsin 53706); Paschos, E.A. Phys. Rev. D 8: No. 3, 984-987 (1 Aug 1973).

A practical method of testing the Adler and Gross-Llewellyn Smith sum rules with high-energy neutrino beams is outlined. The test is found to rely only on a knowledge of the relative neutrino and antineutrino fluxes and does not require point-by-point knowledge of the F_2 and F_3 structure functions. This test does rely on the assumption that Bjorken scaling is satisfied. (auth)

3399 MEASUREMENT OF THE $K_S^0 \to \pi^+\pi^-\gamma$ DECAY RATE. Burgun, G. (CEN, Saclay, France); Bertranet, P.; Lesquoy, E.; Muller, A.; Pauli, E.; Zylberajch, S.; James, F.; Montanet, L.; Paul, E.; Saetre, P.; Sendall, D. M. Phys. Lett.; 46B: No. 3, 481-485(1 Oct 1973).

From a study of 70000 K^0 decays in the CERN 2m hydrogen bubble chamber, the rate for $K_S^0 \to \pi^+\pi^-\gamma$ for different cuts in the γ momentum was estimated. The results are in good agreement with inner bremsstrahlung on $K_S^0 \to \pi^+\pi^-$. For γ momentum in the K^0 c.m. greater than 50 MeV/c, one obtains the branching ratio: $\Gamma(K_S \to \pi^+\pi^-\gamma, k > 50\ \text{MeV/c})/\Gamma(K_S \to \pi^+\pi^-) = (2.8 \pm 0.6) \times 10^{-3}$. This leads to an estimate for the direct γ emission process: $\Gamma(K_S \to \pi^+\pi^-\gamma\ \text{direct})/\Gamma(K_S \to \pi^+\pi^-) = (0.3 \pm 0.6) \times 10^{-3}$. (auth)

Strong (Baryon-induced)

Refer also to abstract 3689.

3400 (CNRS-CBH-73-2) STUDY OF THE COHERENT $\bar{p}d \to \bar{n}d\pi^-$ REACTION AT 5.55 GeV/c. Braun, H.; Fridman, A.; Gerber, J. P.; Givernaud, A.; Juillot, P.; Malko, J. A.; Maurer, G.; Voltolini, C.; Cooper, W. A. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires; Argonne National Lab., Ill. (USA)). 1973. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

An analysis of the $\bar{p}d \to \bar{n}d\pi^-$ reactions is presented which is based on 150,000 photographs. Cross sections for all the coherent channels obtained from this experiment are also given. The interpretations of the $\bar{n}\pi^-$ enhancement at 1.3 GeV/c^2 and the d* bump at 2.16 GeV/c^2 observed in the $\bar{p}d \to \bar{n}d\pi^-$ reaction are discussed. Peripheral type models are used to describe some production features of the $\bar{p}d \to \bar{n}d\pi^-$ reaction. The diffraction dissociation aspect of the data is discussed. Helicity conservation in the s or t channel is tested for the $\bar{p}d \to \bar{n}d\pi^-$ channel and also for the $\bar{d} \to \bar{p}d\pi^+\pi^-$ and $\bar{p}d \to \bar{N}d3\pi$ reactions. (auth)

3401 (COO-1112-171) EXPERIMENTS WITH POLARIZED BEAMS AND TARGETS. Krisch, A. D. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). 1972. 22p. (UM-HE-72-22). Dep. NTIS $3.25.

A lecture is given on possible experiments at the ZGS facility, and a discussion of the spin dependence of strong interactions. It is noted that the most interesting experiments will probably be studies of the differences between the various initial spin states in p + p scattering. (JFP)

3402 (COO-1112-173) MEASUREMENT OF P-P INCLUSIVE CROSS SECTIONS AT VERY HIGH ENERGY. Ratner, L. G.; Ellis, R. J.; Vannini, G.; Babcock, B. A.; Krisch, A. D.; Roberts, J. B. (Argonne National Lab., Ill. (USA); Bologna Univ. (Italy); Michigan Univ., Ann Arbor (USA). Dept. of Physics). 1973. 104p. (UM-HE-73-7). Dep. NTIS $7.25.

The differential inelastic cross section $Ed^3\sigma/dP^3$ for particles produced in very high energy proton-proton collisions at the CERN Intersecting Storage Rings was measured. The inclusive reaction $p + p \to x +$ anything, where x was a π^+, K^+, or proton was studied. The momenta of the two colliding beams varied from 15.3 to 26.5 GeV/c. This was equivalent to a single beam of 500 to 1500 GeV/c hitting a target. The dependence of $Ed^3\sigma/dP^3$ on the transverse and longitudinal momenta of the outgoing particles, $P_\perp$ and $P_\parallel$ was measured. It was found that when $Ed^3\sigma/dP^3$ was plotted against $X = P_\parallel/P_{max}$, it was energy independent from 12 to 1500 GeV especially for π^+ data. This supports a type of scaling suggested by Feynman and Yang et al. At small X, the pion cross section has a flat maximum, while the proton cross section decreases slightly. When plotted against $P_\perp^2$, the pion and proton cross sections both behave as at lower energies; $\sim\exp(-4.0P_\perp^2)$. The pion cross section has a distinct forward peak $\exp(-10^2_\perp)$ which is absent in the proton case. The K^+/π^+ ratio is about 10% with rather poor statistics. (auth)

3403 (COO-1112-185) REMARK ABOUT THE FRACTION OF SINGLE DISSOCIATION. VanderVelde, J. (Michigan Univ., Ann Arbor (USA)). [nd]. 3p. (CONF-730642-11). Dep. NTIS $3.00.

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The spectrum of slow protons associated with the various topologies in a sample of 100-GeV p + p interactions in a 30-inch bubble chamber. The diffractive dissociation cross section is discussed. (JFP)

3404 (COO-2009-58) RECENT POLARIZATION RESULTS IN LARGE-ANGLE ELASTIC PROTON-PROTON SCATTERING. Abshire, G. W.; Ankenbrandt, C. M.; Crittenden, R. R.; Heinz, R. M.; Hinotani, K.; Levy, S. L; Neal, H. A.; Rust, D. R. (Indiana Univ., Bloomington (USA). Dept. of Physics). 1973. Contract AT(11-1)-2009. 12p. (CONF-730837-3). Dep. NTIS $3.00.

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973).

The initial results of a large-angle elastic proton-proton polarization experiment which is now in progress at the Argonne ZGS accelerator are discussed. By utilizing, for the first time at high energies, a polarized proton target in an external proton beam, it was possible to significantly expand the t range over which high statistics p-p polarization data are available. Measurements covering the region $30 \lesssim \theta_{CM} \lesssim 90°$ were made at 5.15 and 7.0 GeV/c. Large $|t|$ measurements are presently underway at 12.3 GeV/c. At 5.15 GeV/c a minimum in the polarization near $t = -.8\ (\text{GeV/c})^2$, a smooth increase in the polarization until a maximum is attained near $t = 1.8\ (\text{GeV/c})^2$, and then a monotonic decline in the polarization until the value of zero is reached at $\theta_{CMS} = 90°$ are observed. These data are analyzed in terms of an optical model. (auth)

3405 (INR-1462) MULTIPLICITY OF NEUTRAL PIONS IN HIGH ENERGY COLLISIONS. Bardadin-Otwinowska, M.; Bialkowska, H.; Gajewski, J.; Gokieli, R.; Otwinowski, S.; Wojcik, W. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

The experimental characteristics of the π^0 production in high energy $\pi^- p$ and pp collisions are given. The observed features of charged multiplicity distribution and neutral pion production are described by a phenomenological model which assumes a Czyzewski-Rybicki formula for the total multiplicity distribution and the hypothesis of isospin independence. (auth)

3406 (RLO-2225-T-27-3) PROTON INTERACTIONS IN HEAVY NUCLEI AT 200 GeV. Florian, J. R.; Kirkpatrick, L. D.;

Lord, J. J.; Martin, J.; Gibbs, R. E.; Kotzer, P.; Piserchio, R. (Washington Univ., Seattle (USA)). [nd]. Contract AT(45-1)-2225. 12p. (CONF-730837-2). Dep. NTIS \$3.00.

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973).

Nuclear track emulsions were exposed to 200-GeV protons at the National Accelerator Laboratory. One of the emulsion plates was loaded with granules of tungsten. Interactions in the emulsion and with the tungsten granules were located and angular measurements were made on the shower particles. The average number of charged evaporation particles produced on tungsten was found to be 29.4 ± 4.3, which is much larger than expected. Moreover, the average multiplicity of shower particles is 16.8 ± 3.8, about twice as large as that for p-p interactions. The corresponding values for the emulsion are 7.2 ± 0.5 and 13.9 ± 0.6 for the multiplicity of evaporation and shower particles, respectively. The angular distribution of shower particles produced on tungsten was compared to that for p-p interactions. These data are in qualitative agreement with recent calculations by Fishbane and Trefil. (auth)

3407 (UCI-34-P-149-X-2) STUDY OF PROTON-ANTIPROTON INTERACTIONS AND OTHER HIGH ENERGY STUDIES. Progress Report. Schultz, J.; Condon, P. (California Univ., Irvine (USA)). 1973. Contract AT(04-3)-34. 26p. Dep. NTIS \$3.50.

Progress is reported on research conducted by the High Energy Physics Group of the University of California, Irvine, during the contract year beginning October 1, 1972. Work was performed on four distinct high energy investigations: completion of analysis and preparation of reports on a study of proton-antiproton interactions between 0.7 and 1.1 GeV/c in the BNL 30-inch hydrogen bubble chamber; preparations for analysis of an antiproton exposure in the 30-inch deuterium-filled chamber in the momentum range 0.5 to 0.9 GeV/c; preliminary work on a hybrid experiment to be run during the next year at SLAC, investigating K^0_L interactions in hydrogen and deuterium between 2 and 15 GeV/c; and hardware development toward a projected study of very small angle proton-proton elastic scattering at LAMPF, for the purpose of testing dispersion relations predictions. A list of publications is included. (auth)

3408 PROBLEM OF FIREBALLS AND ISR RESULTS. Miesowicz, M. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol.; B4: No. 5, 647-653(1973).

The relevance of ISR results concerning particle production for the fireball model is discussed. It is argued that there is no contradiction between the ISR data and cosmic ray data concerning the rapidity distribution. The evidence of cluster production is discussed. (auth)

3409 SEARCH FOR MAGNETIC MONOPOLES IN LUNAR MATERIAL USING AN ELECTROMAGNETIC DETECTOR. Ross, R.R.; Eberhard, P.H.; Alvarez, L.W. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Watt, R.D. Phys. Rev. D 8: No. 3, 698-702 (1 Aug 1973).

Our search for magnetic monopoles in lunar materials has been concluded with the exploration of an additional 11.5 kg of material returned by 11, 12, and 14 missions, using a modified version of our electromagnetic detector. Again, no magnetic monopole was detected. Combining these results with the results of our previous experiment, we set an upper limit of 1.7×10^{-4} monopoles/g for the density of isolated monopoles in the lunar surface and improve our upper limits set for the monopole flux in cosmic rays and for monopole pair-production cross section. (auth)

3410 CERTIFICATION OF THREE OLD COSMIC-RAY EMULSION EVENTS AS Ω^- DECAYS AND INTERACTIONS. Alvarez, L.W. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 8: No. 3, 702-711 (1 Aug 1973).

In the "pre-accelerator years," when large stacks of emulsion were exposed to cosmic rays at high altitude, three events were found in which K^- mesons were emitted from slowly moving particles. The Ω^- is the only presently known particle that can give rise to a K^- when moving at nonrelativistic speed, but none of the three events has until now been clearly identified as an Ω^-. One of the cosmic-ray events (Eisenberg, 1954) has been incorrectly interpreted as an Ω^- decaying in flight; it is now shown to be an interaction in flight of an Ω^- with a silver nucleus. The second event is a clear-cut example of an Ω^- decaying in orbit, bound to an emulsion nucleus. The third event is quite complicated, but can be unambiguously attributed to the decay of an Ω^- atomically bound to an N^{14} nucleus, followed by a collision of the daughter Λ with the N^{14}, in which the compound system then fragments into ${}_{\Lambda}C^{13} + p + n$. The mass of the Ω^- as determined by each of the last two events (Fry et al., 1955) agrees closely with the mean of all bubble-chamber events. (auth)

3411 TOTAL CROSS SECTION MEASUREMENT AT THE ISR. Amendlia, S. R. (Univ., Pisa, Italy); Bellettini, G.; Braccini, P. L. Nuovo Cim.; 17A: No. 4, 735-755(21 Oct 1973).

The first results of an experiment at the CERN intersecting storage rings, which measures the total cross section in proton-proton collisions are presented. The equivalent laboratory momenta are 291, 496, 1068 and 1480 GeV/c. A direct measurement was made of σ_T as the ratio between the total interaction rate and the machine luminosity. A detailed description of the experimental apparatus and of the analysis procedure is given. It is found that σ_T increases by about 10% in the energy region studied. (auth)

3412 MEASUREMENT OF THE ANGULAR DISTRIBUTION OF INVERSE PHOTODISINTEGRATION OF THE DEUTERON AS A TEST OF TIME REVERSAL INVARIANCE. Goldhagen, P. E. Princeton, NJ; Princeton Univ. (1973). 149p. University Microfilms Order No. 73-23,201.

Thesis (Ph. D.).

The angular distribution of $n + p \to d + \gamma$ was measured at neutron kinetic energies of 475, 560, 625, and 750 MeV. An intense neutron beam was prepared by allowing deuterons accelerated in the Princeton-Pennsylvania Accelerator to strip in an internal beryllium target. Velocities and angles of the particles were determined using accurate time-of-flight techniques and magnetostrictive read-out wire spark chambers. Results based on 31000 events at nine scattering angles are reported and compared with existing data for the inverse reaction $\gamma + d \to n + p$. The angular distributions are found to agree, as predicted by time-reversal invariance. (Diss. Abstr. Int., B)

3413 CHASTITSY VYSOKIKH ENERGII V KOSMICHESKIKH LUCHAKH. (High Energy Particles in Cosmic Radiation). Grigorov, N. L.; Rapoport, I. D.; Shestoperov, V. Ya. Moscow; Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko Matematicheskoi Literatury (1973). 306p.

The ionization calorimeter as a method of determining primary cosmic ray energies from 10^{11} to 5×10^{12} ev is discussed. Ionization detectors in hodoscopic array and scintillation counters are discussed. Methods of studying the interaction characteristics of cosmic rays of known energy with atomic nuclei are discussed under the following headings: combining a Wilson chamber and spark chamber with an ionization calorimeter, counting electron-photon cascades by nuclear photoemulsions, probability of finding showers in nuclear emulsions from ionization chamber readings, the use of controlled nuclear photoemulsions in large piles to count showers, methods of accelerating the search for electromagnetic cascades in nuclear emulsions, and timed selection of electron-photon showers as shown by nuclear emulsions. The role of pions from high energy cosmic rays in the lower parts of the atmosphere, "young" atmospheric showers, a study of the interaction characteristics of particles having energies greater than 10^{12} eV with light atomic nuclei by the use of controlled nuclear photoemulsions, the generation of high energy pions in cosmic rays, and a study of the interaction characteristics of hadrons with matter by means of the ionization calorimeter and the Wilson chamber are considered. The outlook for studying cosmic ray particles of very high energy on earth and in space is given. (SJR)

3414 FORMATION STUDY OF $N\bar{N}$ INTERACTIONS BETWEEN 1.09 AND 3.45 GeV/c. IV. Features of Annihilations Into $K\bar{K}$ and π Mesons. Oh, B. Y.; Eastman, P. S.; Ming Ma, Z.; Parker, D. L.; Smith, G. A.; Sprafka, R. J. (Michigan State Univ., East Lansing). Nucl. Phys.; B63: 1-27(1973).

Final state resonance production and single particle momentum spectra are presented for $p\bar{p}$ annihilations into $K\bar{K}$ and π's between 1.09 and 3.45 GeV/c. Resonance production generally agrees with the Lamb statistical model. Momentum spectra of K's and π's are independent of incident energy, while the mean multiplicity increases in proportion to the c.m. energy, supporting the annihilation model of Jacob and Nussinov. (auth)

3415 REACTION OF $np \to pp\pi^-$ BETWEEN 1.0 AND 8.0 GeV/c. Ansorge, R. E.; Maden, D.; Neale, W. W.; Rushbrooke, J. G. (Cavendish Lab., Cambridge, Eng.). Nucl. Phys.; B63: 93-113(1973).

Results for 3564 events of the type $np \to pp\pi^-$ are presented. The events were obtained in a hydrogen bubble chamber exposed to a neutron beam. The incident momentum distribution of the events is approximately uniform in the range 1.0 – 7.5 GeV/c. The physical distributions are found to be in good agreement with the predictions of a one pion exchange model incorporating a recent phase shift analysis of pion-nucleon scattering and using the off-mass-shell corrections of Benecke-Dürr and Dürr-Pilkuhn. Certain discrepancies between our results and previous studies of the reaction in deuterium are found. In particular no evidence is found for anomalous $N^*(1450)$ production and discrepancies are found in certain momentum transfer distributions. (auth)

3416 $pp \to \gamma$ + ANYTHING AT THE ISR AT $E_{cm} = 44.4$ GeV AND ITS IMPLICATIONS FOR π^0 PRODUCTION AND MULTIPLICITY. Daniel, R. R.; Ganguli, S. N.; Gurtu, A.; Malhotra, P. K. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys.; B63: 45-53(1973).

The angular and momentum distributions of γ-rays, produced in pp collisions at the CERN ISR at a center of mass energy of 44.4 GeV, were measured using nuclear emulsions. This experiment covers an angular region $27° < \theta_{cm} < 88°$ which had not been covered in an earlier ISR experiment. Using the entire available γ-ray data, the π^0 angular distribution were deduced. The average π^0 multiplicity is found to be $\langle N_{\pi^0} \rangle = 4.0 \pm 0.6$. Using this value, the average charged particle multiplicity is deduced to be $\langle N_{ch} \rangle = 10.6 \pm 1.4$. (auth)

3417 CERTAIN CHARACTERISTICS OF INELASTIC PROTON–NUCLEON INTERACTIONS AT 200 GeV/c. Alma-Ata Leningrad-Moscow-Tashkent Collaboration. JETP Lett. (USSR) (Engl. Transl.); 17: No. 12, 456-459(20 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 12, 655-658(20 Jun 1973).

There were 294 proton–proton and 337 proton–neutron quasifree inelastic collisions out of 4078 events of inelastic interaction of protons with momentum 200 GeV, found in 1438 m of proton tracks in nuclear emulsion separated. Analysis of the angular characteristics of the secondary charged relativistic particles shows that the showers are anisotropic up to maximum multiplicity and are inhomogeneous, probably as a result of the tendency of the particles to cluster. (auth)

3418 SPECTROSCOPY OF THE HYPERNUCLEUS Λ-C^{12}. CERN. Heidelberg-Warsaw Collaboration. Phys. Lett.; 46B: No. 3, 468-470(1 Oct 1973).

Kaons were stopped in a ^{12}C target. The momenta of pions accompanying the kaon interactions were measured with a magnetic spectrometer. States in $^{12}_{\Lambda}$C with binding energies of the Λ particle of 11 ± 1 MeV and 0 ± 1 Mev were observed. (auth)

3419 OBSERVATION OF π^0 MESONS WITH LARGE TRANSVERSE MOMENTUM IN HIGH ENERGY PROTON–PROTON COLLISIONS. Buesser, F. W. (CERN, Geneva); Camilleri, L.; Di Lella, L.; Gladding, G.; Placci, A.; Pope, B. G.; Smith, A. M.; Yoh, J. K.; Zavattini, E.; Blumenfeld, B. J.; Lederman, L. M.; Cool, R. L.; Litt, L.; Segler, S. L. Phys. Lett.; 46B: No. 3, 471-476(1 Oct 1973).

Invariant cross sections are presented for the inclusive reaction $p + p \to \pi^0$ + anything. Measurements of large transverse momentum π^0's (2.5 GeV/c $< p_\perp < 9$ GeV/c) were made near 90° at the CERN ISR at five center-of-mass energies ($\sqrt{s} = 23.5$, 30.6, 44.8, 52.7 and 62.4 GeV). At large $p_\perp$, the invariant cross sections are seen to vary with s and $p_\perp$, in good agreement with a fit of the form $Ap_\perp^{-n}F(p_\perp/\sqrt{s})$, with $n \approx 8$ and $F(p_\perp/\sqrt{s}) \approx \exp(-26p_\perp/\sqrt{s})$. (auth)

3420 AZIMUTHAL CORRECTIONS FOR PP COLLISIONS AT 20 TO 70 GeV AND THE MULTIPERIPHERAL MODEL. Azimov, S. A.; Bondarenko, A. I.; Gulamov, K. G.; Petrov, V. I.; Riskiev, T. T.; Trofimova, L. P.; Cernova, L. P.; Chernov, G. M. (Physical-Technical Inst., Tashkent, USSR). JETP Lett. (USSR) (Engl. Transl.); 17: No. 12, 459-461(20 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 12, 659-662(20 Jun 1973).

The distributions of the angles between the transverse momenta of secondary particles from pp collisions were investigated as functions of p_0 (21, 50 and 67 GeV/c), the multiplicity, and the difference of the longitudinal momenta. The data contradict qualitatively the multiperipheral model. (auth)

3421 SLOPE PARAMETER AND REAL PART OF THE PN ELASTIC SCATTERING AMPLITUDE IN THE ENERGY RANGE 10 TO 70 GeV. Beznogikh, G. G.; Buyak, A.; Zhidkov, N. K.; Zayachki, V. I.; Zolin, L. S.; Kirillova, L. F.; Nikitin, V. A.; Sviridov, V. A.; Truong Bien; Shafranova, M. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 2, 348-352(Aug 1973). (In Russian).

Basing on experiments investigating the elastic pd and pp small-angle scatterings, carried out at the Serpukhov accelerator in the energy range 10 to 70 GeV, the slope parameter for the pn-scattering differential cross section and α_{pn} (the ratio of the real to imaginary part for the forward pn-scattering amplitude) are determined in framework of the Glauber model. The quantities for the pn scattering are shown to be close to those for the pp scattering: the slope parameter increases with the energy, α_{pn} is negative and its modulus decreases in accordance with the predictions of the dispersion relations. (auth)

Strong (Meson-induced)

Refer also to abstract 2783.

3422 (COO-2009-59) POLARIZATION OF THE RECOIL PROTON IN THE REACTIONS $\pi^\pm p \to pX^\pm$ IN THE A_2 REGION. Abshire, G. W.; Ankenbrandt, C. M.; Brabson, B. B.; Crittenden, R. R.; Heinz, R. M.; Hinotani, K.; Mott, J. E.; Neal, H. A.; Pawlicki, A. J. (Indiana Univ., Bloomington (USA). Dept. of Physics). 1973. Contract AT(11-1)-2009. 11p. (CONF-730837-4). Dep. NTIS $3.00.

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973).

The results are presented of an experiment to study the polarization of the recoil proton in the reaction $\pi^\pm p \to pX^\pm$ at 4 GeV/c incident pion momentum, where M_x varies from 1200 to 1450 MeV and t varies from $-.2$ to $-.8$ (GeV/c)^2. The polarization of the recoil proton normal to the scattering plane was measured with a wire chamber carbon analyzer. Polarizations are presented as a function of mass M_x for all t, and as a function of t for all masses. The typical error in the polarization is ± 0.1. A significant difference is observed in the behavior of the polarization associated with the X^+ and X^-. Possible implications of this disparity are explored. (auth)

3423 (COO-3023-17) HIGH ENERGY PHYSICS PROGRESS REPORT. Cormack, A. M. (Tufts Univ., Medford, Mass. (USA)). Oct 1973. Contract AT(11-1)-3023. 71p. Dep. NTIS $5.75.

Experimental research on strong interactions is summarized. A list of publications is included. (JFP)

3424 (JINR-P1-7027) CROSS SECTIONS OF CHANNELS AND RESONANCES IN SIX-PRONG πp INTERACTIONS AT 5 GeV/c. Abesalashvili, L.; Shpiring, K.; Glagolev, V. V.; Kuznetsova, E. S.; Lebedev, R. M.; Saitov, I. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 20p. (In Russian). (CONF-720923-16). Dep. NTIS (U. S. Sales Only) $3.00.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

About 3.5 thousand events with 6 prongs were measured in $\pi^- p$ interactions at 5 GeV/c. The cross sections for various reaction channels and resonance production are given in Tables I and II. In the channel without neutral particles abundant production of Δ^{2+} and ρ^0 is observed. There is an evidence for a heavy isobar production as well. In the channel with one neutral pion abundant production of Δ^{2+}, and ω^0, η^0 and clear signals of x^0 (958) are observed. In the angular distribution of the ω^0 production two peaks are observed: one which is dominant–in the forward direction and the other–in the backward direction. In the mass spectrum of $\pi^+\pi^-\pi^0$–combinations there is a significant bump at the mass of ρ^0(1019) as well. In the channel with a neutron and no other neutral particles there is a strong evidence for Δ^- production. The results at 5 GeV/c are compared with those at other energies. (auth)

3425 (JINR-P1-7268) CHARACTERISTICS OF THE EVENTS FORMED IN $\pi^- p$ INTERACTIONS AT $p = 40$ GeV/c. Alma-Ata Budapest-Bucharest-Warsaw-Dubna-Krakow-Moscow-Sofia-Tashkent-Tbilisi-Ulan-Bator-Hanoi Collaboration. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 32p. (In Russian). Dep NTIS (U. S. Sales Only) $3.75.

Asymmetries in the production of secondary particles in $\pi^- p$ interactions at momenta of 40 GeV/c were analyzed. By means of the asymmetry parameter it was shown that there exist two classes of interactions of π mesons with protons. In one the particles are produced from stationary centers in the center of mass system and in the other from centers moving in the center of mass system. The properties of the two groups of events (structure functions, multiplicity, mean energies of the particles) were studied. The characteristics of the momentum spectra of the particles in the center of mass system, aligned in order of the decrease in the forward and backward hemispheres, were examined. It was shown that in the distribution according to the rate of the mean different, the rate $\langle \Delta y^* \rangle$ between the extreme particles and particles neighboring it is larger than between internal particles at all multiplicities from 4 to 10. (tr-auth)

3426 (PI-1-202) PHOTOPRODUCTION OF ETA-MESON ON HYDROGEN AT PHOTON ENERGIES BETWEEN 1.5 AND 2.2 GeV. Christ, A.; Husmann, D.; Jansen, W.; Loehr, B.; Reichelt, T.; Schilling, H. (Bonn Univ. (West Germany). Physikalisches Institut). Jul 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

The differential cross section of the process $\gamma p \to \eta p$ was measured at the Bonn 2.5 GeV Electron Synchrotron for mean photon energies between 1.5 and 2.2 GeV at c.m. angles around 35° corresponding to an almost constant momentum transfer of -0.27 GeV^2. The data show a smooth energy dependence. (auth)

3427 SEARCH FOR THE χ^0 MESON IN THE DIMUON DECAYS OF K_L^0. Hladky, J. (Inst. of Physics CSAV, Prague); Novak, M.; Prokes, A.; Votruba, J.; Kiss, D.; Nagy, E.; Urban, L.; Krivokhizhin, V. G.; Likhachev, M. F.; Savin, I. A.; Vovenko, A. S. Lett. Nuovo Cim.; 8: No. 6, 361-364(6 Oct 1973).

A spark chamber spectrometer was used to search for the χ^0 meson by means of the decay mode $K_2^0 \rightarrow X^0 + \gamma \rightarrow \mu^+ + \mu^- + \gamma$. The $M_{\mu^+\mu^-}$ effective mass distribution is shown. There is no significant structure of the dimuon invariant-mass distribution in the whole interval of a possible χ^0 meson mass. An upper limit of $8(10)^{-3}$ was found for the studied decay mode. (JFP)

3428 GENERAL CHARACTERISTICS OF 50 GeV/c π^--NUCLEON INTERACTIONS IN EMULSION. Bhowmik, B.; Kaul, S. K.; Singh, S. (Univ. of Delhi). Lett. Nuovo Cim.; 8: No. 8, 503-508 (20 Oct 1973).

The results are reported on coherent-production multiplicity, angular and rapidity distributions of the secondary particles produced in the interactions of 50 GeV/c π^- with nucleons (free or quasi-free) of emulsion nuclei. The significant characteristics of the distributions are discussed. (LBS)

3429 ρ-MESON PRODUCTION IN THE REACTION $\pi^\pm p \rightarrow \rho N$ AT 6 GeV/c. Gordon, H. A.; Lai, K.; Scarr, J. M. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. D 8: No. 3, 779-799 (1 Aug 1973).

We present a systematic study of the reactions $\pi^+p \rightarrow \rho^+p$, $\pi^-p \rightarrow \rho^0n$, and $\pi^-p \rightarrow \rho^-p$ at 6 GeV/c. Differential cross sections and density-matrix elements are presented. Structures of the isospin-zero and isospin-one contributions in the t-channel exchange are observed, and implications to two-body models are discussed. Finally a simple model to describe the $\pi^\pm p \rightarrow \rho N$ amplitude is proposed. (auth)

3430 STUDY OF $K^+P \rightarrow K^+P2\pi^+2\pi^-$ AT 12.7 GeV/c. Jain, P.L.; Labuda, W.M.; Ahmad, Z.; Pappas, G. (High Energy Experimental Laboratory, Department of Physics, State University of New York at Buffalo, Buffalo, New York 14214). Phys. Rev. D 8: No. 3, 738-753 (1 Aug 1973).

We present the results of the reaction $K^+p \rightarrow K^+p2\pi^+2\pi^-$ at 12.7 GeV/c. These results are compared with the predictions of the model developed by Chan, Łoskiewicz, and Allison (the CŁA model) and with a modified form of this model. With the addition of resonance production to the model, adequate predictions of the experimental distributions are obtained. The data were also analyzed in terms of the quark model for hadronic structure which is revealed through the distributions of longitudinal momentum, transverse-momentum squared, and the rapidity for the negative pions. (auth)

3431 SOME PROPERTIES OF INCLUSIVE REACTIONS $\pi^-p \rightarrow \pi^\pm + \ldots$ AND $\pi^-n \rightarrow \pi^\pm + \ldots$ AT THE MOMENTUM OF 40 GeV/c. Alma-Ata-Budapest-Bucharest-Warsaw-Dubna-Krakow-Moscow Serpukhov-Sofia-Tashkent-Tbilisi-Ulan-Bator-Hanoi Collaboration. Yadern. Fiz.; 18: No. 3, 545-553 (Sep 1973). (In Russian).

The experimental data on inclusive reactions $\pi^-p \rightarrow \pi^\pm + \ldots$ and $\pi^-n \rightarrow \pi^\pm + \ldots$ at $p = 40$ GeV/c are presented. The absolute cross section of the reaction $\pi^-p \rightarrow \pi^\pm + \ldots$ at $x \approx 0$ coincides with the results obtained at ISR (CERN) at $E_p = 500 - 1500$ GeV. A similar result has been obtained for inclusive processes $\pi^-p \rightarrow \gamma + \ldots$, as well. Thus, in the "central region" the structure functions are similar for π^-p and pp collisions at $E_p = 500 - 1500$ GeV. If the scale invariance in pp collisions takes place at $E_p \approx 1000$ GeV, in π^-p interactions one can observe it already at $p = 40$ GeV/c. (auth)

3432 CHARGE EXCHANGE REACTION $K^-p \rightarrow \overline{K}^0n$ AT MOMENTUM OF 39 GeV/c. Baloshin, O. N.; Blagorodov, A. M.; Bolonkin, B. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 3, 542-544 (Sep 1973). (In Russian).

Measurements of the charge exchange reaction $K^-p \rightarrow \overline{K}^0n$ at the momentum of 39 GeV/c, obtained by means of a magnetic spectrometer with spark chambers, are presented. Momentum transfer dependence of the differential cross section $d\sigma/dt$ is compared with predictions of the Regge-pole model. (auth)

3433 STUDY OF η' IN 2.18 GeV/c K^-p INTERACTIONS. Kiang, R. K. S. Ann Arbor, MI; Univ. of Michigan (1973). 139p. University Microfilms Order No. 73-24,606.

Thesis (Ph. D.).

The BNL 31-inch bubble chamber, filled with liquid hydrogen and 4 mole-percent neon, was exposed to a separated K^- beam at the AGS of Brookhaven National Laboratory. Approximately one million pictures were taken at 2.18 GeV/c. Zero-, two-, and four-prong-V events were scanned for the reaction $K^-p \rightarrow \Lambda\eta'$. The sample of 1482 ± 66 η' events obtained amounts to the sum of all the η' samples from previous experiments. The reactions $\eta' \rightarrow \pi^+\pi^-\gamma$, $\eta' \rightarrow \pi^+\pi^-\eta_N$, and $\eta' \rightarrow \pi^+\pi^-\eta_C$ were analyzed to determine the η' quantum numbers. The fit to the mass spectrum of the $\pi^+\pi^-\eta_N$ channel, which has the most η' signal and the least background, yields $m_{\eta'} = 958.53 \pm 0.65$ MeV/c^2 and $\Gamma_{\eta'} = 1.70 \pm 0.82$ MeV/c^2. Dalitz distributions were examined. Strong evidence is presented that the η' quantum numbers are $J^P = 0^-$, and $J^P = 2^-$ is very unlikely. Using the 2% branching fraction of $\eta' \rightarrow \gamma\gamma$, as an input, the η' branching fractions were obtained as $\Gamma(\pi\pi\eta)/\Gamma(\text{all}) = 69.8 \pm 3.8\%$ and $\Gamma(\pi^+\pi^-\gamma)/\Gamma(\text{all}) = 28.2 \pm 4.0\%$. No new decay mode is discovered. Also a study of the detection of γ in the bubble chamber is presented. (Diss. Abstr. Int., B)

3434 RESONANCE PRODUCTION AND PHASE SHIFTS IN THE $\pi^+\pi^-$ SYSTEM FROM THE REACTION $\pi^+n \rightarrow p\pi^+\pi^-$ AT 6 GeV/c. Weisser, F. J. Jr. Pittsburgh; Carnegie-Mellon Univ. (1973). 136p. University Microfilms Order No. 73-22,887.

Thesis (Ph. D.).

A study of the $\pi^+\pi^-$ system produced in the reaction $\pi^+n \rightarrow p\pi^+\pi^-$ at 6 GeV/c is presented. The mass, width, total cross section, and differential cross section ($d\sigma/dt$) of the ρ°, f°, and g° mesons are measured. No structure is observed in either the f° or g° mass regions. The cross sections for backward ρ° and f° production are measured. Momentum transfer dependent structure in the ρ° and f° density matrix elements was observed, and it was found that the ρ° structure at high t can be explained by A_2 exchange. Using a one-pion-exchange-absorption model a $\pi^+\pi^-$ phase shift analysis is done for the region 0.6 to 1.4 GeV. All partial wave amplitudes having angular momenta ≤ 3 are used. Below 0.9 GeV the "down" solution for the isospin zero s-wave phase shift is found to be strongly favored. A sharp rise is observed in the s-wave phase shift at about 0.98 GeV and a sharp drop is observed in the s-wave inelasticity at about 1.0 GeV. The s-wave phase shift is found to pass through 90° near GeV and through 270° near 1.10 GeV. In the f° mass region the s-wave amplitude is elastic within errors and the s-wave phase shift rises slowly. The d-wave inelasticity dips in the 1.0 GeV region and drops rapidly above 1.3 GeV. The p and f-wave amplitudes are found to be elastic within errors throughout the mass range. (Diss. Abstr. Int., B)

3435 DIFFERENTIAL CROSS SECTION NEAR 180° IN ELASTIC K^+ PROTON SCATTERING BETWEEN 1.0 AND 1.5 GeV/c. Adams, U. Seattle; Univ. of Washington (1973). 195p. University Microfilms Order No. 73-22,547.

Thesis (Ph. D.).

A spark chamber experiment was performed to measure the elastic differential cross section between $-1.0 \leq \cos \leq -.985$ in K^+p scattering. The momentum of the incident kaons was chosen between 1.0 and 1.5 GeV/c in steps of 50 MeV/c. No structure was observed in the K^+p differential cross section. Hence, it was concluded that the exotic Z_1^* (1910) resonance does not exist. The data agrees well with other experiments. $d\sigma/du$ (K^+p) is found to vary like $d\sigma/du \sim (s-M^2-\mu^2)^{-4.9}$. This indicates that Regge exchange in the u-channel dominates the scattering amplitude in the backward direction, and that Regge fits are applicable even in the intermediate energy region of this experiment. (Diss. Abstr. Int., B)

3436 REACTION $\pi^- + p \rightarrow \Lambda^\circ + K^\circ$ AT SEVEN INCIDENT MOMENTA FROM 998 TO 1044 MeV/c. Snape, G. R. , Philadelphia; Univ. of Pennsylvania (1973). 133p. University Microfilms Order No. 73-24,224.

Thesis (Ph. D.).

The reaction $\pi^- + p \rightarrow \Lambda^\circ + K^\circ$ was studied at seven incident momenta from 998 to 1044 MeV/c. A triggering system selected events with an all-neutral final state and two charged particles appearing downstream. Spark chambers were used to measure the direction of the incident pion and of the proton and the pion from lambda decay; in addition, the decay proton momentum was measured by range. The angular distributions in the production center-of-mass were fit to Legendre polynomials; terms in P_3 were required, though terms in P_2 seemed small. The total cross section was relatively flat at about 700 μb, and no indication was seen of narrow peaks or structure near sigma threshold. The differential polarization was fit to associated Legendre polynomials; no terms beyond $P^1/_2$ were needed. (Diss. Abstr. Int. B)

3437 INVESTIGATION ON THE B^- PRODUCED IN $\pi^-p \rightarrow p\omega\pi^-$ AT 9.1 GeV/c. Armenise, N. (Univ., Bari, Italy) Fogli Muciaccia, M. T.; Silvestri, A.; Forino, A.; Gessaroli, R.; Lendinara, L.; Quàreni Vignudelli, A.; Cartacci, A. M.; Dagliana, M. G.; di Caporiacco, G.; Parrini, G. Lett. Nuovo Cim.; 8: No. 7, 425-430 (13 Oct 1973).

An analysis of the B^- resonance produced in the reaction $\pi^- + p \rightarrow p + \omega + \pi^-$ at 9.1 GeV/c in a hydrogen bubble chamber is presented. The mass distributions, cross sections, and the positions, experimental widths, and intensities of the B^- resonance are found. A 1^+ assignment is found for the B^-. (JFP)

3438 STRANGE PARTICLE PRODUCTION IN 5 GeV/c π^+p COLLISIONS. Bonn-Durham-Nijmegen-Paris E.P.-Torino Collaboration. Nucl. Phys.; B63: 248-276 (1973).

Results are presented on strange particle channel and reaction cross sections in 5 GeV/c π^+p collisions. For the (quasi-) two body reactions $\pi^+p \rightarrow \Sigma^+K^+$, $\pi^+p \rightarrow \Sigma^+K^{*+}(890)$, $\pi^+p \rightarrow \Sigma^+(1385)K^+$ and $\pi^+p \rightarrow \Sigma^+(1385)K^{*+}(890)$ the differential cross sections and spin density matrix elements are given. A_2^0 and f^0 production in the $(K\bar{K})^0$ mode is estimated using a technique which eliminates A_2^0/f^0 interference. Proton dissociation into strange particle pairs is investigated. A comparison is made of some of our reactions with their SU(3)-symmetric $\bar{K}N$ counterparts. (auth)

3439 REACTION $\pi^-p \rightarrow \pi^-\pi^-\pi^+p$ AT 25 AND 40 GeV/c. CERN-IHEP BOSON SPECTROMETER GROUP. Nucl. Phys.; B63: 141-152(1973).

The reaction $\pi^-p \rightarrow \pi^-\pi^-\pi^+p$ was measured at 25 and 40 GeV/c at the Serpukhov proton accelerator. The production cross section as a function of beam energy, momentum transfer, and 3π mass is presented, and results of the partial-wave analysis of the 3π system are discussed. (auth)

3440 A_1, A_2, AND A_3 PRODUCTION IN $\pi^-p \rightarrow \pi^-\pi^-\pi^+p$ AT 25 AND 40 GeV/c. CERN–IHEP Boson Spectrometer Group. Nucl. Phys.; B63: 153-174(1973).

A sample of ~70,000 fitted events of the reaction $\pi^-p \rightarrow \pi^-\pi^-\pi^+p$ at 25 and 40 GeV/c was obtained with the CERN-IHEP boson spectrometer at the Serpukhov accelerator. A partial-wave analysis shows that (i) A_1 and A_3 cannot be described by a Breit–Wigner amplitude, (ii) the A_2 can be well described by a Breit–Wigner amplitude, (iii) although A_1, A_3 and A_2 have different properties, the energy dependence of their production cross section is similar. (auth)

3441 DECAY CHANNEL $A_2^- \rightarrow \eta\pi^-$ IN THE REACTION $\pi^-p \rightarrow p\pi^-\pi^+\pi^-\pi^0$ AT 40 GeV/c. CERN–IHEP Boson Spectrometer Group. Nucl. Phys.; B63: 175-181(1973).

The branching ratio $A_2^- \rightarrow \eta\pi^-/A_2^- \rightarrow \rho\pi = 0.22 \pm 0.03$ (statistical error; systematic error ± 0.02) at 40 GeV/c was measured. From an analysis of the decay angular distribution a $J^P = 2^+$ wave in a pure $|M| = 1$ state, produced by natural parity exchange, was found. (auth)

3442 DIFFERENTIAL CROSS SECTIONS AND SCALING IN $\pi^-p \rightarrow X$–p AT 25 AND 40 GeV/c. CERN-IHEP Boson Spectrometer Group. Nucl. Phys.; B63: 182-188(1973).

The reaction $\pi^-p \rightarrow X^-p$ was investigated at $p_{inc} = 25$ and 40 GeV/c at the Serpukhov accelerator. Here the differential inelastic cross sections $\Delta^2\sigma/\Delta t\Delta M^2$ are presented as a function of s, t, and M^2 (X^-). The scaling hypothesis was tested. (auth)

3443 ρ^- PRODUCTION IN THE REACTION $\pi^-p \rightarrow \pi^-\pi^0p$ AT 25 AND 40 GeV/c. CERN-IHEP Boson Spectrometer Group. Nucl. Phys.; B63: 189-193(1973).

The ρ^- production cross sections were studied in the channel $\pi^-p \rightarrow \pi^-\pi^0p$ at incident momenta $p_{inc} = 25$ and 40 GeV/c, with momentum transfer to the proton $0.18 \leq |t| \leq 0.32$ $(GeV/c)^2$. The momentum dependence of the total production cross section is found to be $\sigma(\rho^-) \propto p_{inc}^{-1.87\pm0.09}$. (auth)

3444 REACTION $K^-p \rightarrow X_{\bar{K}}p$ AT 25 AND 40 GeV/c. CERN-IHEP Boson Spectrometer Group. Nucl. Phys.; B63: 194-201 (1973).

The reaction $K^-p \rightarrow X_{\bar{K}}p$ was investigated at $p_{inc} = 25$ and 40 GeV/c using the CERN–IHEP boson spectrometer at the Serpukhov accelerator. Here missing-mass spectra and differential inelastic cross sections $\Delta^2\sigma/\Delta t\Delta M^2$ are presented as a function of s, t, and M^2 $(X_{\bar{K}})$. (auth)

3445 PRODUCTION OF $K^{*-}(890)$ AND $K^{*-}(1420)$ IN THE REACTION $K^-p \rightarrow (K_\pi)^-p$ AT 25 AND 40 GeV/c. CERN-IHEP Boson Spectrometer Group. Nucl. Phys.; B63: 202-210(1973).

The reaction $K^-p \rightarrow X_{\bar{K}}p$ was measured at 25 and 40 GeV/c at the Serpukhov accelerator using the CERN-IHEP boson spectrometer. At both energies production of the resonances $K^{*-}(890)$ and $K^{*-}(1420)$ was observed in the channels $K^{*-} \rightarrow K^0\pi^-$ and $K^-\pi^0$; the momentum dependence of their production cross sections is found to be $\sigma[K^{*-}(890)] \propto p_{inc}^{-1.48\pm0.04}$ and $\sigma[K^{*-}(1420) \propto p_{inc}^{-0.8\pm0.2}$. (auth)

3446 SIMULTANEOUS RESONANCE PRODUCTION IN QUASI-THREE-BODY REACTIONS IN K^+p INTERACTIONS AT 8.25 GeV/c. Eskreys, A. (Inst. of Nuclear Physics, Krakow); Figiel, J.; Malecki, P.; Zalewska, A.; Zalewski, K.; de Beare, W.; de Wolf, E. Nucl. Phys.; B63: 28-44(1973).

Quasi-three-body channels with simultaneous production of two resonances are studied in K^+p interactions at 8.25 GeV/c. Estimation of their cross sections shows that they account for up to 20 percent of the total cross section for the fitted channels of the four prong plus V^0 topology. An analysis of the production mechanism is performed using the LPS method (the hexagon plot). Transverse momentum distributions and $p_T - p_L$ correlations are studied and it is found that they are strongly affected by resonance production. (auth)

3447 PROPERTIES OF THE INELASTIC K^+p REACTIONS BETWEEN 1.2 AND 1.7 GeV/c. Berthon, A. (CERN, Geneva); Montanet, L.; Paul, E.; Saetre, P.; Sendall, D. M.; Bertranet, P.; Burgun, G.; Lesquoy, E.; Muller, A.; Pauli, E.; Zylberajch, S. Nucl. Phys.; B63: 54-92(1973).

The observation of 70,000 $K^0p\pi^+$ events produced with K^+ incident momenta of 1.21, 1.29, 1.38 and 1.69 GeV/c allows a detailed description of the production and decay of the $\Delta(1236)$ and $K^*(892)$ resonances which dominate the $K^0p\pi^+$ final state. No striking variations with energy are observed. The associated production of Δ and K^* near threshold shows striking similarities with the same production at higher energy. (auth)

3448 PRODUCTION OF γ QUANTA IN π^- N INTERACTIONS AT 40 GeV/c. Bucharest-Budapest-Krakow-Dubna-Hanoi-Serpukhov-Sofia-Tashkent-Tbilisi-Ulan Bator-Warsaw Collaboration. Nucl. Phys.; B63: 114-126(1973).

Data on the average multiplicity of neutral pions are presented for π^-p, π^-n and π^-C interactions at 40 GeV/c, based on the statistics of 9,432 γ-quanta. A significant increase was found in the average number of π^0s per inelastic event as a function of the number of charged particles for these interactions. Average momenta and angular characteristics of the γ-quanta are presented in both the lab. and the c.m. systems. It can be concluded that there is a plateau [in the $-1 \leq y^* \leq 1$ interval] in the $(1/\sigma_{in})\, d\sigma/dy^* = f(y^*)$ distribution of γ-quanta for π^-p interactions and the value of the π^-p cross section at $y^* = 0$ agrees quite well with the pp cross section at p = 500 – 1500 GeV/c. This is in favor of the scaling hypothesis in the central region $y^* = 0$ for 40 GeV/c π^-p interactions. (auth)

3449 SCALING IN PARTIAL-WAVE INELASTICITIES AND KNO SCALING. Dias de Deus, J. (Univ. of Copenhagen). Lett. Nuovo Cim.; 8: No. 7, 476-480(13 Oct 1973).

The inelastic cross section in a collision of particles A and B and the number n of produced particles at a given impact parameter b were written as functions of the geometric scaling variable b′ as $b'^2 = \pi b^2/\sigma_{AB}^{inel}(s)$ in the following way: $-d\sigma_{AB}^{inel}/db^2 = \pi\rho(b'^2)$ (2) and $n(b^2,s) = \langle n(s)\rangle\phi[\rho(b'^2)]$ (3). From 2 and 3 the KNO scaling is derived. In order to gain more confidence in the impact parameter approach to the multiplicity distributions relations 2 and 3 are checked experimentally separately as well as combined. (JFP)

3450 MEASUREMENT OF THE POLARIZATION IN $K^-p \rightarrow \bar{K}^0n$ CHARGE EXCHANGE AT 8 GeV/c. Beusch, W. (CERN, Geneva); Borchini, M.; Misuri, G.; Polgar, E.; Webdale, D.; Gentit, F. X.; Fluri, L.; Freudenreich, K.; Muehlemann, P.; Wilson, J. A.; Astbury, P.; Gallivan, J.; Jafar, J.; Letheren, M.; LeDu, P.; Guisan, O. Phys. Lett.; 46B: No. 3, 477-480(1 Oct 1973).

The $K^-p \rightarrow \bar{K}^0n$ polarization was measured at 8 GeV/c and for $-t$ values ranging from 0 up to 1.2 $(GeV/c)^2$. A negative polarization was found. (auth)

3451 RESULTS ON THE PRODUCTION CROSS SECTIONS $\pi^-p \rightarrow$ NEUTRALS AND $\pi^-p \rightarrow x^0n \rightarrow 2\gamma n$ AT 3.8, 6, 8, AND 12 GeV/c. Apel, W. D. (Kernforschungszentrum, Karlsruhe, Ger.); Auslaender, J.; Mueller, H.; Sigurdsson, G.; Staudenmaier, H. M.; Bertolucci, E.; Mannelli, I.; Pierazzini, G.; Rehak, P.; Scribano, A.; Sergiampietri, F.; Vincelli, M. L. Phys. Lett.; 46B: No. 3, 459-464(1 Oct 1973).

The ratio between the cross sections for the reactions $\pi^-p \rightarrow \pi^0_{2\gamma}n$ and $\pi^-p \rightarrow \eta_{2\gamma}n$ was measured to be $(2.4 \pm 0.9) \times 10^{-2}$, $(2.1 \pm 0.6) \times 10^{-2}$, $(1.8 \pm 0.6) \times 10^{-2}$ and $(2.8 \pm 1.3) \times 10^{-2}$ at 3.8, 6, 8 and 12 GeV/c incident momentum respectively. At the same momenta the cross section for $\pi^-p \rightarrow$ neutrals is (1.48 ± 0.09) mb, (0.86 ± 0.05) mb, (0.64 ± 0.04) mb and (0.42 ± 0.03) mb. (auth)

3452 SCALING TEST IN π^-p SEMI-INCLUSIVE REACTIONS. Balea, E. (Inst. for Atomic Physics, Bucharest, Romania); Balea, O.; Boldea, V.; Felea, S.; Pantea, D.; Ponta, T.; Besliu, C.; Cotorobai, F.; Nicorovici, N. Phys. Lett.; 46B: No. 3, 389-391 (1 Oct 1973).

The scaling properties of the semi-inclusive reactions $\pi^-p \rightarrow \pi^- + (n-1)$ charged + neutrals at 7.5 and 21 GeV/c are analyzed. The distributions of the h-functions on the x-variable for π^- particles indicate the presence of a limited scaling. The choosing of a certain value for the reduced charged multiplicity $n/\langle n\rangle$ is pointed out. (auth)

Particle Interactions and Properties (Theoretical)

General

3453 (INIS-mf-768) SUMMING THE LEADING TERMS IN THE VECTOR GLUON MODEL. Marques, G. C.; Woo, C. H. (Sao Paulo Univ. (Brazil)). [nd]. 5p.

Although the procedure of summing the leading terms gives, in the neutral vector gluon model, asymptotically damped charge form factors, on-shell and off-shell, when applied to other off-shell form factors the procedure gives results not fulfilling gauge invariance. (auth)

3454 (IS-3300) 1972 ANNUAL SUMMARY REPORT. Progress and Plans. (Ames Lab., Iowa (USA)). Oct 1973. Contract W-7405-eng-82. 143p. Dep. NTIS $5.45.

Collections of abstracts of papers published during the previous calender year in high and low energy physics, mathematics and computers, chemistry, and metallurgy and materials research are presented. (JFP)

3455 (RL-73-62) DUALITY AND THE REGGE APPROACH TO INCLUSIVE REACTIONS. Hong-Mo, C. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Jul 1973. 84p. Dep. NTIS (U. S. Sales Only) $6.25.

The subject is dealt with in sections: the generalized optical theorem; limiting fragmentation and scaling; the approach to scaling; exoticity and early scaling; the Reggeon-particle amplitude and the triple-Regge expansion; factorization (pomeron exchange, Regge poles); semi-local duality; applications of semi-local duality; beyond single particle distributions. (UK)

3456 CORRELATIONS IN INCLUSIVE AND SEMI-INCLUSIVE REACTIONS. Yaes, R. J. (Memorial Univ. of Newfoundland, St. John's, Nova Scotia). Lett. Nuovo Cim.; 8: No. 6, 365-370(6 Oct 1973).

For the study of correlations in cross sections of inclusive and semi-inclusive interactions a simple model with all produced particles identical and spinless is considered. It is indicated which of the results are applicable to more realistic cases and in particular to the case where differentiation is made between charged and uncharged particles. Semi-inclusive correlation functions are defined and the consequences investigated. (JFP)

3457 GROUND-STATE MASS AND THE CRITICAL DIMENSION OF SPACE-TIME IN DUAL-RESONANCE MODELS. Minami, M. (Kyoto Univ.). Lett. Nuovo Cim.; 8: No. 6, 391-395 (6 Oct 1973).

It is pointed out that the ground-state mass squared associated with the dual-resonance propagators, which were previously defined as natural generalizations of the conventional Feynman propagator can also be given by the formula $-\delta/24 = m_0^2$ in a point-like picture limit. (JFP)

3458 CHARGE ALGEBRA WITHIN INFINITE PARTICLES. Celeghini, E.; Sorace, E.; Zappa, G. (Univ., Florence). Nuovo Cim.; 18A: No. 1, 17-30(1 Nov 1973).

A study is made of angular conditions in the saturation of the chiral charge algebra at $p_z = \infty$ within infinite one-particle states. It is shown that the previously introduced operator $u(\theta Z)$ cannot suffice to satisfy covariance constraints. The scheme of quarks in a harmonic potential is preserved and a closed but physically unsatisfactory solution is given. Later on, using the whole harmonic-oscillator algebra an adiabatic perturbative method is presented which allows angular conditions to be satisfied step by step at any order and overcomes all the difficulties of the first solution. Some phenomenological considerations are then developed. (auth)

3459 DIMENSIONAL REGULARIZATION AND PCAC. Akyeampong, D. A.; Delbourgo, R. (Imperial Coll. of Science and Tech., London). Nuovo Cim.; 18A: No. 1, 94-104(1 Nov 1973).

In a space-time of arbitrary even dimension neither the mass term nor the kinetic-energy term of the free spinor Lagrangian is chirally invariant. A generalized sigma-model is constructed whereby the divergence of the axial current is converted into the sum of two distinct pion fields. The first pion couples in the conventional manner with the fermion whereas the second pion couples through the anomalous kinetic-energy interaction $\bar{\psi}\overleftrightarrow{\partial}^{J}\Gamma_{[J}\Gamma_{K}\Gamma_{L}\Gamma_{M}\Gamma_{N]}\tau\psi$. This second coupling disappears from all tree graphs as we descend to four dimensions, but through closed fermion loops is responsible for all the anomalous meson interactions. The <AAA> and <VAAA> anomalies are thereby calculated in terms of the <VVA> anomaly. (auth)

3460 MULTIPLE PRODUCTION AND INTERFERENCE OF PARTICLES EMITTED BY MOVING SOURCES. Kopylov, G. I.; Podgoretskii, M. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 3, 656-666(Sep 1973). (In Russian).

Interference phenomena arising when among products of a multiple production process there are identical particles with close moments, are considered. It is shown that a distribution of the momentum differences enables one to estimate a shape and a lifetime of the region where the multiple production proceeds. (auth)

3461 SUM RULES FOR INCLUSIVE CROSS SECTIONS AND CORRELATION FUNCTION WITH ACCOUNT OF MULTIPOMERON EXCHANGES. Shoikhet, V. Kh. (Tbilisi State Univ., USSR). Yadern. Fiz.; 18: No. 3, 583-594(Sep 1973). (In Russian).

Sum rules for multipomeron "inclusive vertices" are obtained. Sum rules for the correlation function with account of the multipomeron exchanges are studied. It is shown that the sum rules for "inclusive vertices" provide self-consistency of those for the correlation function. (auth)

3462 CHARACTER OF INCLUSIVE SPECTRA AND FLUCTUATIONS IN INELASTIC PROCESSES DUE TO MULTIPOMERON EXCHANGE. Abramovskii, V. A.; Gribov, V. N.; Kancheli, O. V. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 3, 595-616(Sep 1973). (In Russian).

The problem is investigated of which absorptive parts of the reggeon graphs for σ_{tot} are not small in asymptotics $s \to \infty$; a corresponding classification of essential inelastic processes is presented. Only those absorptive parts are not small for which a reggeon is cut as a whole or is not at all cut. For the physically interesting case of the n-reggeon exchange these absorptive parts are expressed explicitly via the n-reggeon contribution to σ_{tot}. The obtained relations show that the main part of the j-plane branch points does not contribute to the inclusive cross sections. Main corrections to the scaling form of the spectrum arise from one-loop contributions to the vertex functions and to the pomeron propagators. Their explicit form is determined by the three-reggeon vertex only. Asymptotics of the two-particle correlation function ρ_2 in the central region is also determined by the three-reggeon vertex only and decreases logarithmically with relative rapidity parameter, conserving its positive sign. In the last section fluctuations in distributions of produced particles in individual events are studied. For this purpose a conception is suitable of the inclusive cross section $\hat{f}$ for a given type of inhomogeneity in the spectrum. The $\hat{f}$ quantities are expressed via the absorptive parts of the diagrams for the pomeron propagator. It is shown that the final particle density distribution is quite inhomogeneous; the distribution for fluctuations with ranges $\geq \lambda$, in the rapidity units, is of the Poisson form with the mean fluctuation number $\sim \lambda^{-2} \ln s$. (auth)

3463 DILATATION CHARGE. Bandelloni, G. (Univ., Genoa). Lett. Nuovo Cim.; 8: No. 7, 431-434(13 Oct 1973).

Some problems related to the definition and properties of the dilatation charge in the symmetric and nonsymmetric cases are discussed. A perturbative model-dependent approach to whatever order is used in deriving a Ward-like identity which relates the time integral of the n-point Green function, where the dilatation charge was inserted, with differential operators acting on the n-point renormalized Green functions. (JFP)

3464 ANALYSIS OF ONE-PARTICLE DISTRIBUTIONS AND INCLUSIVE REACTION ASYMMETRIES WITHIN THE COMPLETELY SYMMETRIC DUALITY SCHEME. Hosoda, M.; Inagaki, H. (Tokyo Metropolitan Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 5, 1642-1655(May 1973).

The one-particle distribution spectra, the averaged multiplicities, and the spin dependences of high energy inclusive reactions are treated from the viewpoint of Regge theory within the M(12) symmetry scheme. The quark-line-duality diagrams for clarifying the dynamics and provide sum-rule relations among the distribution spectra, averaged multiplicities and proton target asymmetries which are testable in various kinematical regions are taken into account. The existence of exotic resonances is discussed. (auth)

Electromagnetic

Refer also to abstracts 3614 and 4423.

3465 (BNL-18283) BREMSSTRAHLUNG RADIATION IN HIGH ENERGY PARTICLE COLLISIONS IN THE VISIBLE REGION. Goldhaber, M.; Muzinich, I. J. (Brookhaven National Lab., Upton, N. Y. (USA)). Aug 1973. 4p. Dep. NTIS $3.00.

Some features of bremsstrahlung radiation are reviewed for visible region photons with possible applications to ISA luminosity measurements. (auth)

3466 (DESY-73/21) GENERALIZED VECTOR DOMINANCE. Schildknecht, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Jun 1973. 60p. (CONF-730334-9; CONF-730450-2). Dep. NTIS (U.S. Sales Only) $5.00.

From 8th Recontre de Moriond conference; Meribel-les-Allues, France (4 Mar 1973).

A lecture is given on ρ^0, ω, and ϕ dominance in photoproduction and low q^2 electroproduction and inelastic electron scattering in generalised vector dominance. (JFP)

3467 (JINR-P2-7178) RADIATIVE SCATTERING IN THE REGION OF $\Delta(1236)$ RESONANCE. Mussakhanov, M. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The model discussed gives the possibility for the extraction of the contribution of $\Delta(1236)$ magnetic moment to the radiative π^+p cross section. The soft pion limit investigation yields the relations between parameters of the radiative π^+p-scattering amplitude and parameters of the amplitude of pion production by neutrino. The fitting of the last experimental data gives for isobar magnetic moment value $\mu_{\Delta^{++}} = 3.6 \pm 2$. (auth)

3468 (ORO-3992-43) CHARGED VECTOR MESONS AND ξ FORMALISM. Hsu, J. P. (Texas Univ., Austin (USA). Center for Particle Theory). Sep 1973. 13p. (CPT-93). Dep. NTIS $3.00.

A finite ξ formalism for the electromagnetic interaction of a massive charged vector meson with an arbitrary magnetic moment κ is discussed. The theory is Lorentz covariant, renormalizable, and guage invariant. The case $\xi = \kappa = 1$ is considered to show that the theory is unitary after introducing a fictitious particle and two new vertices in the theory. (auth)

3469 (ORO-3992-140) MASSLESS PARTICLE DECAY. Gleiser, R. J. (Texas Univ., Austin (USA). Center for Particle Theory). 1973. Contract AT(40-1)-3992. 22p. (CPT-25). Dep. NTIS $3.25.

A Hamiltonian model of Lorentz invariant particle interactions is used as a framework in an attempt at describing massless particle decay. By restricting to the two particle sector an exact solution is found for the time development of the survival probability. Several modes are obtained and discussed. In particular it is shown that the presence of a persistent mode, i.e., the case in which the survival probability has a nonzero limiting value, has to be interpreted as indicating that the massless particle is a stable bound state. (auth)

3470 OSCILLATIONS OF THE E. M. FORM FACTOR AND P–P ELASTIC CROSS SECTION. Campani, E.; Fiorentini, G. (Scuola Normale Superiore, Pisa, Italy). Lett. Nuovo Cim.; 8: No. 11, 675-680(10 Nov 1973).

The Chow-Yang model is used to connect the oscillation observed in a recent measurement of the proton electromagnetic form factor and a similar structure observed in high-precision measurements of pp elastic cross sections at ISR energies. In this model, the pp scattering amplitude is approximated with the Glauber series of the scattering amplitudes of elementary particles; the distribution of constituents inside the proton (hadronic-matter density) is postulated to coincide with the electric-charge distribution.

3471 PAIR PRODUCTION BY A PERIODIC ELECTRIC FIELD. Narozhnyi, N. B.; Nikishov, A. I. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 3, 862-874 (Sep 1973). (In Russian).

The formation of boson and fermion pairs by a homogeneous periodic field during a finite time T is considered. The Klein–Gordon equation and quadrated Dirac equation in this field reduce to the Hill equation; however, only in the boson case are all of the equation parameters real. This is one of the factors which radically affects the solutions for the physical values of the quantum numbers. In the boson case unstable solutions exist which exponentially depend on time and correspond to exponential growth of the mean number of pairs in a given quantum state. (The exponential dependence of the amplitude on T goes over to the usual linear dependence only for quantum numbers corresponding to the boundary of the instability region.) There are no unstable solutions for the physical values of the quantum numbers in the spinor case and correspondingly the probability for pair production in a given state oscillates in time, remaining, as one would expect, less than unity. (auth)

3472 DEEP INELASTIC ELECTRON–NUCLEON SCATTERING: A MODEL FOR THE FINAL STATE. Pavkovic, M. I. (New York Univ., NY). Lett. Nuovo Cim.; 8: No. 6, 386-390(6 Oct 1973).

A model for the final state of deep inelastic electron–nucleon scattering in which the nucleon is a highly composite object is considered. It was previously shown that the variable $1-\xi$ (ξ is the scaling variable $\xi = q^2/2M_{\text{nucleon}}\,\nu$, $0 < \xi \leq 1$) can be interpreted as the speed (measured in units of the speed of light and in the infinite-momentum Lorentz frame) with which the dynamical disturbances travel through the hadronic matter in the deep inelastic electron–nucleon collisions. This conclusion has far reaching consequences and enables one immediately to derive a number of strong qualitative predictions concerning the character of the final hadronic products of the reaction. (JFP)

3473 POTENTIAL BETWEEN A QUARK AND A DIQUARK. Ono, S. (Tokyo Univ.). Lett. Nuovo Cim.; 8: No. 6, 378-382 (6 Oct 1973).

The cross sections of the process $e + p \rightarrow e + N^*$ are considered in a previous two-body baryon model in which baryons are two-body systems of quarks and diquarks. It is shown that the modified Woods–Saxon potential gives correct values not only for the ratio $(d\sigma/d\Omega)(N^*)/(d\sigma/d\Omega)$(elastic) but also for $(d\sigma/d\Omega)(N^*)$ and $(d\sigma/d\Omega)$(elastic) themselves. (JFP)

3474 TAYLOR'S NONCLASSICAL THEORY OF MAGNETIC MONOPOLES AS A SPONTANEOUSLY BROKEN $U_{L1} \times U_{R1}$ MODEL. Acharya, R.; Horvath, Z. (Dublin Inst. for Advanced Studies). Lett. Nuovo Cim.; 8: No. 8, 513-519(20 Oct 1973).

It is pointed out that Taylor's nonclassical theory of magnetic monopoles suffers from one serious drawback: that the axial-vector current for zero monopole mass is not divergence-free; there is a triangle anomaly. It is shown that the anomaly can be removed by extending the $SU_{L2} \otimes U_{R1}$ model of Salam and Weinberg to incorporate hadrons. (LBS)

3475 DIFFRACTIVE SCATTERING OF PHOTONS FROM HADRONS. Drechsler, W.; Grifols, J. A. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nuovo Cim.; 18A: No. 1, 55-74(1 Nov 1973).

A multichannel impact-parameter formalism is developed to describe the diffractive interaction of photons with nucleons. The Pomeranchuk contribution in high-energy Compton scattering and diffractive photoproduction processes is derived in an effective two-particle description satisfying s-channel unitarity and is found not to require the introduction of singular residues. The relation of this description to the conventional vector-meson dominance model is discussed, and an analysis of high-energy data on forward Compton scattering on protons and neutrons within this unitarized impact parameter framework is presented. (auth)

3476 ELECTRON–DEUTERON SCATTERING AND TWO–PHOTON EXCHANGE. Franco, V. (Physics Department, Brooklyn College of the City University of New York, Brooklyn, New York 11210). Phys. Rev. D 8: No. 3, 826-828 (1 Aug 1973).

The general expression for the electron–deuteron scattering amplitude is derived within the framework of Glauber theory. An approximation to this expression, used earlier, is shown to be valid at large, but not at small, momentum transfers. Two–photon exchange effects are somewhat smaller than previously thought. A simple extrapolation of the data does not indicate two–photon exchange dominance at large momentum transfers. Existing data indicate that because of interferences, two–photon exchange effects can change the cross section by $\approx$ 10% for $-t \approx 1\ (\text{GeV}/c)^2$. (auth)

3477 PHOTON STRUCTURE FUNCTIONS FOR THE ANNIHILATION, PROCESS $e^+e^- \rightarrow n\pi^+n\pi^- + \gamma$. Buchl, R. A.; Nigam, B.P. (Department of Physics, Arizona State University, Tempe, Arizona 85281). Phys. Rev. D 8: No. 3, 829-832 (1 Aug 1973).

The differential cross section for the annihilation process $e^+e^- \rightarrow X + \gamma$ is compared with the cross section calculated by Terazawa for the colliding–beam process $e^+e^- \rightarrow n\pi^+n\pi^- + \gamma$, thereby approximating X to be $n\pi^+n\pi^-$. We thus obtain the contribution to the annihilation photon structure functions $\tilde{W}_i^\gamma(q^2, \nu)$ due to the n pion pairs. These functions are found to be related to the structure functions $W_i^\gamma(q^2, \nu)$ for the electroproduction process $e^- + \gamma \rightarrow n\pi^+n\pi^- + e^-$ by a valid continuation. (auth)

3478 COINCIDENCE ELECTROPRODUCTION REACTIONS AND POSITIVITY RESTRICTIONS. De Rújula, A. (Service de Physique Théorique, Centre d'Etudes Nucléaires de Saclay, B.P. n° 2–91 —Gif-sur-Yvette, France); Doncel, M.G.; de Rafael, E. Phys. Rev. D 8: No. 3, 839-847 (1 Aug 1973).

Processes of the type lepton + nucleon → lepton + hadron + hadronic debris are discussed, from a phenomenological point of view, when the target is polarized along an arbitrary direction and the lepton beam is longitudinally polarized or unpolarized. The most general correlation function is explicitly given in terms of the 18 structure functions which govern this process in the one–photon exchange approximation. The positivity domain of the structure functions is worked out and optimal positivity bounds for spin asymmetries are derived. (auth)

3479 CONSTANT-s LIMIT IN ELECTROPRODUCTION. Vinciarelli, P. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 8: No. 3, 965-968 (1 Aug 1973).

We exhibit a light–cone analysis of the large–momentum–transfer limit of the electroproduction structure function W_2 at constant missing mass and of its connection with the Bjorken limit. Testable predictions are made and, with the help of intuitive arguments, an interpretation is offered for known features of the electroproduction data. (auth)

3480 RADIATIVE CORRECTIONS TO $e^+e^- \rightarrow \mu^+\mu^-$ AND NEUTRAL CURRENTS IN UNIFIED GAUGE THEORIES. Dicus, D.A. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 8: No. 3, 890-894 (1 Aug 1973).

Expressions are given for the part of the radiative corrections to the process $e^+e^- \rightarrow \mu^+\mu^-$ which are asymmetric in the cosine of the scattering angle. These corrections are compared with the correction due to the exchange of a neutral vector meson expected in some gauge theories. Given these results it is easy to determine what result should be expected from a measurement of $d\sigma(\theta) - d\sigma(\pi - \theta)$ if the gauge theories are correct (or incorrect). This result will be independent of any unknown parameters of the gauge theory. The effects of the neutral vector meson on the reaction $e^+e^- \rightarrow e^+e^-$ are also given. (auth)

3481 STABILITY OF THE CLASSICAL ELECTRON. Chiang, C.C. (Center for Particle Theory, University of Texas, Austin, Texas 78712). Phys. Rev. D 8: No. 4, 1025-1027 (15 Aug 1973).

In this paper we show that in the classical theory of the electron, with the introduction of a shadow electromagnetic field, the electron is stable in the point-particle limit. (auth)

3482 ANOMALOUS WARD IDENTITIES AND π^0 PRODUCTION. Raval, V.M.; Ramachandran, R. (Indian Institute of Technology, Kanpur, India). Phys. Rev. D 8: No. 4, 1144-1150 (15 Aug 1973).

We have studied the effect of an anomalous term in both vector and axial-vector Ward identities for the axial-vector-vector-vector vertex function on π^0 production in the process $ee \rightarrow ee\pi^0$ in the region of the spacelike masses for the photons. In particular, the behavior of the differential cross section, if observed experimentally, will help distinguish between the various possibilities and possibly identify the presence of the anomaly in the vector Ward identity. (auth)

3483 EIKONAL APPROXIMATION FOR THE BILOCAL VERTEX FUNCTION AND νW_2 IN A FERMION-NEUTRAL-VECTOR-GLUON MODEL. Eichten, E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8: No. 4, 1219-1225 (15 Aug 1973).

The eikonal approximation is used to investigate the forward one-fermion matrix element of the bilocal operator that appears in the most singular term of the canonical light-cone current commutators for the fermion-neutral-vector-gluon model. A relationship is exhibited between this matrix element of the bilocal operator and the leading behavior of νW_2. This relation allows calculations of contributions to the matrix element of the bilocal operator to be applied to the corresponding contribution to νW_2. A simple set of graphs contributing to the matrix element of the bilocal operator is calculated in the eikonal approximation. This gives a contribution to νW_2 in agreement with explicit calculations in perturbation theory for the corresponding set of graphs of νW_2. (auth)

3484 NON-ABELIAN COMPTON SCATTERING ON TARGETS OF ARBITRARY SPIN. Ragusa, S. (Departamento de Física e Ciência dos Materiais Instituto de Física e Química de São Carlos-Universidade de São Paulo, 13560-São Carlos, São Paulo, Brasil). Phys. Rev. D 8: No. 4, 1190-1194 (15 Aug 1973).

The scattering of isovector photons on targets of arbitrary spin S is studied up to second order in the frequency of the incident photon. A general proof is given of all the isospin-antisymmetric low-energy theorems that have been conjectured for arbitrary spin, based on the results obtained for low-spin targets. (auth)

3485 MAGNETIC-TRANSITION FORM FACTOR OF THE $\Delta(1236)$ IN A VENEZIANO-TYPE REPRESENTATION. Dominguez, C.A. (Departmento de Física, Centro de Investigación y de Estudios Avanzados del Instituto Politecnico Nacional, Apdo. Postal 14-740, Mexico 14, D.F.). Phys. Rev. D 8: No. 3, 980-981 (1 Aug 1973).

A Veneziano-type expression is proposed for the magnetic-transition form factor of the $\Delta(1236)$. The agreement with present experimental data up to $-t = 2.34$ (GeV/c)^2 is found to be quite satisfactory. (auth)

3486 TWO-PHOTON CROSS SECTION FOR W-PAIR PRODUCTION BY COLLIDING BEAMS. Pesic, P.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8: No. 3, 945-952 (1 Aug 1973).

We calculate the total cross section for $e^+e^- \rightarrow e^+e^-W^+W^-$, a process which proceeds via two virtual photons. If the intermediate boson ($W^{\pm}$) has no anomalous magnetic moment and pointlike vertices, this process can yield a larger cross section than the one-photon process $e^+e^- \rightarrow W^+W^-$ at sufficiently high energies. Otherwise, the one-photon mechanism is dominant. Numerical results for several values of m_W and the magnetic moment are presented. The effect of Z exchange in a Weinberg-type model is shown to be negligible in these results. (auth)

3487 LIGHT CONE, REGGE BEHAVIOR, AND SINGLE-PARTICLE ELECTROPRODUCTION. Schwimmer, A. (California Institute of Technology, Pasadena, California 91109). Phys. Rev. D 8: No. 3, 974-977 (1 Aug 1973).

Using light-cone dominance and the assumption of Regge behavior for matrix elements of bilocal operators, it is shown that in the large-ω limit three scaling regions develop: the nucleon fragmentation region, the plateau, and the hole fragmentation region proposed by Bjorken. Relations for the charge content of the different regions are discussed. (auth)

3488 PROTON-NEUTRON MASS DIFFERENCE IN A UNIFIED THEORY OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Fayyazuddin (International Centre for Theoretical Physics, Trieste, Italy); Riazuddin. Phys. Rev. D 8: No. 4, 1179-1185 (15 Aug 1973).

The question of cancellation of the logarithmic divergence appearing in the proton-neutron mass difference is studied in a unified theory of weak and electromagnetic interactions. It is concluded that the contribution from weak hadronic currents in an extension of the Salam-Weinberg model for leptons to hadrons does not cancel the logarithmic divergence arising from purely electromagnetic interactions. (auth)

3489 DETERMINATION OF FORM FACTOR FOR THE $\gamma p\Delta^+_{1236}$ VERTEX AT THE MOMENTUM TRANSFER UP TO 0.4 (GeV/c)^2. Titov, Yu. I.; Severin, N. F.; Akhmerov, R. V. (Kharkov Physical-Technical Inst.). Yadern. Fiz.; 18: No. 3, 537-541(Sep 1973). (In Russian).

Results are presented of determination of the form factor for the $\gamma p\Delta^+_{1236}$ vertex in the momentum transfer interval 0.07 – 0.38 (GeV/c)^2. The threshold cross sections measured with high statistical precision are used to diminish the ambiguity in separation of the resonance and the background contributions. A model is analyzed to estimate ambiguity of the method used to determine the vertex form factor. (auth)

3490 ANGULAR DISTRIBUTION OF PHOTON BREMSSTRAHLUNG AT COLLISION OF ULTRARELATIVISTIC ELECTRONS. Fadin, V. S.; Khoze, V. A. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 3, 560-570(Sep 1973). (In Russian).

Bremsstrahlung at collisions of ultrarelativistic electrons and positrons is considered. Expressions for the photon angular distributions, valid for all the angles ϑ_k and frequencies ω (except of the hard end of the spectrum), are obtained with logarithmic accuracy. The case when the incident particles have transverse polarization is also considered. Applicability is analyzed of the Weizsacker–Williams method, of the classical current method, and of the electron propagator pole approximation for getting the angular distributions and spectra in cms and ls. (auth)

3491 IS THE K^+-K^0-MESON MASS DIFFERENCE OF PURE ELECTROMAGNETIC ORIGIN? Molchatskii, L. S. (Kuybyshev Agricultural Inst., USSR). Yadern. Fiz.; 18: No. 3, 571-573(Sep 1973). (In Russian).

The K^+-K^0-meson mass difference is investigated in framework of the bootstrap model of kaon as a bound state in the $\overline{\Lambda}N$ system. It is shown that the abnormal kaon mass difference is evidently related to existence of a qualitative effect arising from the π^0-meson exchange in the t channel of the reaction $\overline{\Lambda}N \rightarrow \overline{\Lambda}N$. The contribution from this effect to the mass difference is found to be substantial, as the strong coupling is "partly switched on" in the $\Lambda\Lambda\pi^0$ vertex. The last is a result of an electromagnetic mixing of the isotopic pure states $\Lambda_t \Sigma^0_t$ and $\pi^0_t \eta_t$. (auth)

3492 DO THE SEPARATE CHANNELS IN THE DEEP INELASTIC ELECTRON–NUCLEON SCATTERING SCALE INDIVIDUALLY? Pavkovic, M. I. (New York Univ., NY). Lett. Nuovo Cim.; 8: No. 7, 401-404(13 Oct 1973).

Working within the unified approach to resonances and partons it is affirmed that individual channels that open up at high energies in deep inelastic electron–nucleon scattering also scale individually. (JFP)

3493 SCALE DIMENSION AND THE ELASTIC FORM FACTOR. Hirayama, M. (Toyama Univ., Japan). Lett. Nuovo Cim.; 8: No. 7, 435-438(13 Oct 1973).

The asymptotic behavior of the electromagnetic form factor of the pion F_π was studied previously in the context of the operator-product expansion near the light cone. It was suggested that the asymptotic behavior of F_π will be determined by the scale dimension of the interpolating field of the pion. The quantity F_π was suggested to behave as $F_\pi(q^2) \sim (q^2)^{1-d_\pi}$ (q_μ large and spacelike) where d_π and q^2 are the scale dimensions of the interpolating pion field and the momentum transfer squared, respectively. This problem is reanalyzed, and it is indicated that $F_\pi(q^2)$ does not necessarily depend on d_π. (JFP)

3494 OPTIMAL INFORMATION FOR THE PION FORM FACTOR FROM ANALYTICITY AND EXPERIMENTAL DATA. Nenciu,

G. (Inst. for Atomic Physics, Bucharest); Raszillier, I.; Schmidt, W.; Schneider, H. Nucl. Phys.; B63: 285-300(1973).

A method is developed to derive optimal information on the pion electromagnetic form factor from analyticity and experimental data. The approach takes into account the statistical nature of errors. The meaning of a best analytic form factor is defined and its expression is derived for different data sets. χ^2-distributions of the possible values of the form factor in certain points as well as of the mean square pion charge radius around the best values are given. (auth)

3495 POSITIVITY CONSTRAINTS FOR ANOMALOUS DIMENSIONS. Nachtmann, O. (Cornell Univ., Ithaca, NY). Nucl. Phys.; B63: 237-247(1973).

Wilson's operator product expansion is examined. It is shown how to project on operators of definite spin at finite Q^2. Consistency conditions for anomalous dimensions following from positivity are derived using the moment problem. (auth)

3496 QUASI TWO BODY e^+e^- ANNIHILATION. Kramer, G.; Walsh, T. F. (Univ., Hamburg). Z. Phys.; 263: No. 5, 361-386 (1973).

The helicity formalism for e^+e^- annihilation into two-body resonance states is presented, and it is shown how to systematically extract the magnitudes and relative phases of the form factors present in the one-photon exchange approximation. This entails measurement of one-particle density matrices and certain polarization correlations in the final state. As an example, the vector meson dominance expectations for annihilation into meson resonances is discussed, and it is shown how this model can be tested. (GE)

3497 α^3-CONTRIBUTION TO THE ANGULAR ASYMMETRY IN $e^+e^- \rightarrow \mu^+\mu^-$. Berends, F. A. (Univ., Leiden); Gaemers, K. J. F.; Gastmans, R. Nucl. Phys.; B63: 381-397(1973).

The complete α^3-contribution to the angular asymmetry in the differential cross section for $e^+e^- \rightarrow \mu^+\mu^-$ is calculated, including hard photon emission. The results are of interest for e^+e^- colliding beam experiments in which the charges of the outgoing muons are detected. Numerical results are given for the case of experiments with small energy resolutions. (auth)

3498 DEEP INELASTIC PROCESSES. Greco, M. (CERN, Geneva). Nucl. Phys.; B63: 398-412(1973).

Electron-positron annihilation into hadrons, photoproduction, total and singly inclusive electro production are discussed in the framework of a scaling model of electromagnetic interactions in which the photon is coupled to a continuum of hadronic states whose properties are established consistently. The model makes use of the concept of the shrinkage of the size of the particle with its mass. The exhibition of scaling properties in e.m. interactions demands a similar scaling behavior of strong interactions. Predictions are made which are in good agreement with experiments. (auth)

3499 ELECTROPRODUCTION ON NUCLEONS OF MUON PAIR AS A TEST OF THE BILOCAL ALGEBRA. Troost, W.; Verwaest, J. (Univ., Louvain, Belgium). Nucl. Phys.; B63: 413-430(1973).

A full calculation of the cross section for $eN \rightarrow e + (\mu^+\mu^-) +$ hadrons in the deep inelastic region using light-cone algebra is presented. (auth)

3500 TEST OF AMPLITUDE SIGNS IN PION PHOTOPRODUCTION PREDICTED BY THE TRANSFORMATION FROM CURRENT TO CONSTITUENT QUARKS. Gilman, F. J.; Karliner, I. (Stanford Univ., CA). Phys. Lett.; 46B: No. 3, 426-430(1 Oct 1973).

The transformation from current to constituent quark basis states is discussed as it applies to relating amplitudes for photon–nucleon and pion–nucleon decays of baryon resonances. The predictions for the relative signs of pion photoproduction amplitudes proceeding through baryon resonances in the 70 $L = 1$ and 56 $L = 2$ multiplets are presented and compared with experiment. Theory and experiment are found to be completely consistent, with the pion–nucleon decay amplitudes of resonances in the 70 $L = 1$ having the signs characteristic of the $(3,\bar{3})-(\bar{3},3)$ rather than $(8,1)-(1,8)$ term in the transformed axial-vector charge. (auth)

3501 DIFFERENTIAL CROSS SECTIONS FOR PAIR PRODUCTION BY PHOTONS ON ELECTRONS. Jarp, S.; Mork, K. J. Ark. Fys. Seminar Trondheim; No. 7, 35p.(1973).

The cross section for pair production by unpolarized photons on free, unpolarized electrons is differential in four nontrivial variables. This cross section is integrated numerically over two or three of the variables, and various energy spectra and angular distributions are obtained. The calculations are restricted to low photon energies, below 5 MeV, where effects of recoil and exchange are important and may be observed. (auth)

3502 QUARK MODEL RELATIONS FOR THE ELECTROPRODUCTION OF PSEUDOSCALAR MESONS. Krammer, M. (DESY, Hamburg). Rev. Brasil. Fis.; 2: No. 2, 33-38(Aug 1972).

Electroproduction of pseudoscalar mesons $e + p \rightarrow e' + \pi^+ + n$, $e + p \rightarrow e' + \pi^+ + \Delta^0$, $e + p \rightarrow e' + K^+ + \Lambda$, $e + p \rightarrow e' + K^+ + \Sigma^0$, etc., is suggested as a further test to the symmetry relations implied by the quark model. The predictions are compared with recent experimental data. (auth)

Weak

3503 (JINR-P2-7347) DECAYS $K \rightarrow \mu\nu_\mu e^+e^-$, $K \rightarrow e\nu_e\mu^+\mu^-$, $K \rightarrow \mu\nu_\mu\mu^+\mu^-$, $K \rightarrow e\nu_e e^+e^-$. Bardin, D. Yu.; Mitsel'makher, G. V.; Shumeiko, N. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 27p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

Within the framework of the rigid kaon the complete probabilities of the decays $K \rightarrow \mu\nu_\mu e^+e^-$, $K \rightarrow e\nu_e\mu^+\mu^-$, $K \rightarrow \mu\nu_\mu\mu^+\mu^-$, and $K \rightarrow e\nu_e e^+e^-$ were calculated. The relative probabilities are 3×10^{-6}, 0.8×10^{-6}, 10^{-6}, and 2×10^{-7}. The characteristics of each of these processes were determined. It was shown that their study under different kinematic conditions makes it possible to obtain detailed data on the structure of the matrix elements with weak and electromagnetic interactions. (tr-auth)

3504 (ORO-3992-138) FINITE, UNITARY THEORY OF PURE LEPTONIC WEAK INTERACTIONS. Chiang, C. C.; Wang, K. H. (Texas Univ., Austin (USA). Dept. of Physics). 1973. 21p. (CPT-187). Dep. NTIS $3.25.

Based on the V-A interaction, a finite, unitary theory of pure leptonic weak interaction is formulated in the framework of the finite quantum field theory with shadow states. A perturbative series, originated from the conventional expansion is obtained. This new perturbative series converges in the high energy region where the original one does not. The difference between the prediction of this theory and the universal V-A theory is negligible in low energy regions but becomes significant in high energy regions. (auth)

3505 DISCOVERY OF NEUTRAL CURRENTS. Bullock, F. (University Coll., London). New Sci.; 60: No. 866, 16-19(4 Oct 1973).

It is claimed that interactions which are examples of neutral current processes were observed at CERN. Such processes would link together the world of electromagnetic phenomena and that of the weak interactions. This crucial experiment exploited the observational difference between leptons and hadrons. High energy protons, extracted from the proton synchrotron, were allowed to impinge on a heavy metal target. The hadron beam produced, containing a large flux of π and K-mesons passed through the drift space which was terminated by a monumental wall of several tons of iron and concrete. In this wall all the remaining hadrons and mesons were extracted leaving only neutrinos. These traversed a giant bubble chamber. On examining the interaction in the chamber photographically it was found that while the expected processes giving a charged muon were indeed taking place there was, nevertheless, a significant number of interactions where no charged muon appeared among the interaction products. The inference is that these muonless interactions are manifestations of the neutral current process where the lepton coming out of the interaction is a neutrino which cannot, of course, be detected. (UK)

3506 HIGGS SCALARS IN SEMILEPTONIC PROCESSES. Nikolaev, N. N. (Inst. of Theoretical and Experimental Physics, Moscow); Shmatikov, M. Zh. Lett. Nuovo Cim.; 8: No. 11, 685-691 (10 Nov 1973).

Interactions of Higgs scalars are discussed in a gauge theory of weak interactions. The construction of the mass matrix for fermions in vector-like theories similar to the gauge theory is also discussed, a few possible extensions of the gauge model to include hadrons and corrections to interactions of weak charged currents due to exchanges by Higgs $S^\pm$-scalars. It was shown that due to these corrections apparent breaking of the Callen-Freiman relation for K_{e3} form factors is possible, but the Goldberger-Freiman relation survives in its original form. (LBS)

3507 GAMMA($K_L^0 \rightarrow 2\gamma$) IN A RELATIVISTIC QUARK MODEL. Flamm, D. (Institut fuer Hochenergiephysik der Oesterreichischer, Vienna); Kielanowski, P.; Sanchea, J. Lett. Nuovo Cim.; 8: No. 6, 371-372(6 Oct 1973).

A relativistic quark model based on one Bethe–Salpeter equation is used to study the $K_2 \rightarrow 2\gamma$ decay in the pole model with a

V–A quark current interaction. The decay width and Clebsch–Gordon coefficients are found. (JFP)

3508 CONSTRAINT FOR TWO THREE-TRIPLET MODELS FROM LOCAL DUALITY. Schlereth, H. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 8: No. 8, 495-499(20 Oct 1973).

Two three-triplet models were previously developed to decouple the neutral current from the elastic neutrino vertex, and were investigated for their consequences in deep inelastic lepton-hadron scattering. Lower bounds on the mass of the axial-vector form factor are obtained, which serve to discriminate between the two models. (LBS)

3509 BOUNDS ON K_{l3}-DECAY FORM FACTORS. Tataru-Mihai, P. I. (Univ. of Cluj). Acta Phys. Pol.; B4: No. 5, 595-599(1973).

The hyperbolic metric principle is applied to study the bounds on K_{l3}-decay form factors. Some of the results obtained in previous works are rederived and improved. (auth)

3510 HOW TO AVOID $\Delta Y = 1$ NEUTRAL CURRENTS. Schwinger, J. (University of California at Los Angeles, Los Angeles, California 90024). Phys. Rev. D 8: No. 3, 960-964 (1 Aug 1973).

The problem is posed of exhibiting a mechanism that avoids $\Delta Y = 1$ neutral currents without invoking experimentally unknown types of particles. The proposed solution rejects the Cabibbo rotation in favor of a mixing, between two types of unit–spin mesons, that is produced by the SU_3–symmetry–breaking interaction. One quantitative prediction that is well satisfied is the identity of the strong–interaction coupling constants appearing in $\pi^{\pm}$ decay and in $\rho^0 \rightarrow e^+ + e^-$. (auth)

3511 NEW UNIVERSALITY OF WEAK INTERACTIONS AND "UR–CITON SCHEME". Ishida, S. (Department of Physics, College of Science and Engineering, Nihon University, Tokyo, Japan); Oda, M. Phys. Rev. D 8: No. 3, 921-926 (1 Aug 1973).

A new form of universality for weak interactions is proposed, based on the "ur–citon scheme." It enables us, by following simple rules, to derive an effective Hamiltonian for arbitrary weak processes without any parameter except for a universal coupling strength, the Cabibbo angle, and a constant inherent to the "ur–citon scheme." By applying our method to the decay widths of the typical semileptonic and nonleptonic processes our universality is shown to be valid satisfactorily. (auth)

3512 SECOND–ORDER CORRECTIONS TO TRIANGLE ANOMALIES IN AN ABELIAN GAUGE THEORY. Corrigan, D. (Department of Physics, University of Utah, Salt Lake City, Utah 84112). Phys. Rev. D 8: No. 4, 1123-1133 (15 Aug 1973).

We consider an Abelian gauge theory of weak interactions which is arranged so that in lowest order there are no anomalies in the divergence of the axial–vector current. This is done by having two fermions whose couplings to the axial–vector current are equal in magnitude but opposite in sign. We then show that while the second–order corrections to the anomaly are nonzero for each of the fermions, their sum vanishes, ensuring that the theory is anomaly–free through second order. (auth)

3513 CANCELLATION OF DIVERGENCES AND GAUGE INVARIANCE IN THE MASSIVE YANG–MILLS FIELD THEORY. Ivanov, A. N.; Shekhter, V. M. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 3, 630-648(Sep 1973). (In Russian).

Neutrino-neutrino scattering is considered in the massive Yang–Mills vector field theory. All the diagrams of one-loop approximation are calculated in the unitary gauge. The results are presented as sums of these graphs computed in the Feynman gauge and additional terms of three types. The terms of the first type coincide with the contributions from "ghosts" that are well-known to be necessary to introduce when working in a non-unitary gauge. The terms of the second type contribute only to the renormalization constants or are cancelled by counter-terms in order to satisfy the Ward identities. The integrals of the third type diverge quadratically and are shown to cancel themselves when all diagrams are summed up. Therefore, gauge invariance of the amplitude is confirmed by direct computation in spite of non-invariance of Green functions. The cancellation of additional quadratic divergences occurs only in presence of symmetry when all the coupling constants obey the Yang–Mills relations. The results are generalized to the cases of (i) an electron with non-zero mass, (ii) presence of the Higgs scalar particle, and (iii) inclusion of the electromagnetic field (Weinberg model). (auth)

3514 REGULARIZATION OF WEAK INTERACTIONS WITH W BOSONS BY MEANS OF NONPOLYNOMIAL LAGRANGIANS. Abdullaev, F. Kh. (Inst. of Nuclear Physics, Tashkent). Yadern. Fiz.; 18: No. 3, 649-655(Sep 1973). (In Russian).

Weak interactions of muons, hadrons, and charged W bosons are considered in framework of the nonpolynomial Lagrangian field theory. It is assumed that the muon field and the hadron fields interact with an essentially nonlinear massive scalar field. A result of the calculations is that the scalar field inverse coupling constant plays the role of an effective cut-off momentum; and it is shown that the renormalization constant and the mass correction for the muon are finite to the first order in G. (auth)

3515 RENORMALIZABLE MODELS OF WEAK INTERACTION AND NEUTRAL SCALAR MESON. Bogomol'nyi, E. B. (Moscow Physical-Technical Inst.). Yadern. Fiz.; 18: No. 3, 574-582(Sep 1973). (In Russian).

Possibilities to detect experimentally a scalar meson, necessary in most theories of weak interaction, are discussed. It is shown that from the data on the $K^+ \rightarrow \pi^+e^+e^-$ and $K^+ \rightarrow \pi^+\mu^+\mu^-$ decay probabilities it follows that the mass of such a meson must be more than $2m_\pi$. (auth)

3516 CANCELLATIONS OF DIVERGENCES IN FOURTH-ORDER $\mu-\mu$ ELASTIC SCATTERING IN THE GAUGE MODEL OF WEAK INTERACTIONS. Baran, S. A.; Barut, A. O. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 8: No. 11, 716-720(10 Nov 1973).

It is demonstrated that the divergences in the form factor in fourth-order $\mu-\mu$ elastic scattering cancel in the spontaneously broken gauge theory of weak and electromagnetic interactions. (LBS)

3517 RENORMALIZABILITY, GAUGE INVARIANCE, AND $\nu_\mu\nu_e$ SCATTERING IN WEINBERG–SALAM MODEL. Borchardt, S.; Mahanthappa, K. T. (Univ. of Colorado, Boulder). Nucl. Phys.; B63: 445-462(1973).

The amplitude for $\nu_\mu\nu_e$ elastic scattering was calculated to fourth order in R_ξ gauge in the framework of the Weinberg–Salam model to verify renormalizability and gauge invariance. Regularization and renormalization of two-point spinor loop contributions are explicitly carried out and it is shown that the relevant WT-identities are satisfied. Comparative comments on ξ-limiting procedure, R_ξ- and U-gauge calculations are made. (auth)

3518 LOWER BOUNDS TO THE $\nu-e$ AND $\nu-N$ AVERAGED CROSS SECTIONS AT HIGH ENERGIES. Lukaszuk, L. (Institut de Physique Nucleaire, Paris). Nucl. Phys.; B63: 364-380(1973).

It is shown that the weighted average of the weak cross sections over the high-energy region can be bounded from below. The bounds are expressed in terms of coupling constants. (auth)

3519 HIGH ENERGY NEUTRINO SCATTERING AT LOW q^2 AND PARTIAL CONSERVATION OF AXIAL-VECTOR CURRENTS. DeVincenzi, M. (Univ., Rome); Preparata, G. Phys. Lett.; 46B: No. 3, 431-434(1 Oct 1973).

The Adler test of PCAC is extended up to $q^2 \approx -0.2$ GeV^2 in high energy neutrino-nucleon scattering. (auth)

3520 WHAT NEUTRINOS WILL TELL ABOUT GAUGE THEORIES. DeRujula, A.; Glashow, S. L. (Harvard Univ., Cambridge, MA). Phys. Lett.; 46B: No. 3, 377-380(1 Oct 1973).

Neutrino and antineutrino scattering experiments will help determine which, if any, unified gauge theory of weak interactions and electromagnetism is correct. Two sum rules are derived for scattering from targets with roughly equal numbers of protons and neutrons, and it is shown how they may be tested most easily by experiment. (auth)

3521 TESTS OF THE ISOSPIN STRUCTURE OF THE WEAK CURRENT IN NEUTRINO PHYSICS. De Rujula, A.; Glashow, S. L. (Harvard Univ., Cambridge, MA). Phys. Lett.; 46B: No. 3, 381-384(1 Oct 1973).

Most unified gauge theories require that the weak hadron current is not just the Cabibbo current, but contains other terms with different isotopic properties which could contribute significantly to high energy neutrino scattering. Measurements of the four total cross sections (νp, νn, $\bar{\nu}p$, $\bar{\nu}n$) may prove that these additional terms are present, and many reveal their isotopic structure. Tests that depend on the scaling hypothesis, and others that do not, are presented. (auth)

3522 DISTRIBUTION AND POLARIZATION OF Λ PRODUCED FROM β DECAYS OF Ξ. Igarashi, M. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Z. Phys.; 263: No. 5, 425-434 (1973).

The distribution and the polarization of the final baryon are calculated for baryon β decay and for the cascade decay: $\Xi^- \rightarrow \Sigma^0 e(\bar{\nu})(\Sigma^0 \rightarrow \Lambda\gamma)$. These calculations are made under the approximation of neglecting the electron mass and keeping only zeroth and first order terms in the energy release. It is discussed how the weak coupling constants in the cascade decay and in the simple decay $\Xi^- \rightarrow \Lambda e(\bar{\nu})$ can be determined without detection of the emitted γ. (GE)

Strong (General)

Refer also to abstract 3617.

3523 (COO-1112-172) LORENTZ CONTRACTED GEOMETRICAL MODEL. Krisch, A. D. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). 1972. 17p. Dep. NTIS $3.00.

The model assumes that when two high energy particles collide each behaves as a geometrical object which has a Gaussian density and is spherically symmetric except for the Lorentz contraction in the incident direction. Folding the two spatial distributions together the slope (b) of the elastic diffraction peak is obtained in terms of the c.m. velocities (β_i and β_j) and the sizes (A_i and A_j) of the two incident particles. These sizes are assumed to have the experimental s-dependence of $\sigma_{tot} \propto \pi A^2$ for each reaction. The combined s-dependence of the σ_{tot}'s and the β's gives the s-dependence of the elastic slope $[b_{ij}(s) = \frac{1}{2}(A_i^2\beta_i^2 + A_j^2\beta_j^2)\,(\sigma_{tot}^{ij}(s)/\sigma_{tot}^{ij}(\infty))]$. This formula agrees with the experimental slope for p-p, $\bar{p}$-p, K^+-p, K^--p, and $\pi^\pm$-p elastic scattering from 3 to 1500 GeV/c, with only 3 parameters: $A_\pi^2 = 6.1$, $A_K^2 = 3.3$, and $A_p^2 = 10.5$ $(GeV/c)^{-2}$. (auth)

3524 (JINR-P2-7372) QUALITATIVE PICTURE OF HIGH ENERGY HADRON SCATTERING IN SCALAR FIELD THEORY $L_{int} = g\Psi^2\phi$. Barbashov, B. M.; Nesterenko, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 14p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

High energy hadron scattering is studied in the framework of quantum-field model the basis of which are Feynman diagrams with all possible ladder exchanges summed in the eikonal approximation. It is shown that in this approach the main laws of scattering in the energy range $s \sim 10^3$ $(GeV/c)^2$ are obtained. All the parameters, used in considering, are expressed through the coupling constant of strong interactions. To achieve a satisfactory agreement with experimental data it is necessary to take $g^2/4\pi m^2 \sim 25$. (auth)

3525 (LBL-2079) INTRODUCTION TO HADRONIC INTERACTIONS AT HIGH ENERGIES. Jackson, J. D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 84p. Dep. NTIS $6.25.

Lectures are given on total cross sections, elastic scattering and two-body processes, (in which crossing symmetry, signature, power law behavior and phase, Pomeranchuk theorems, Froissart bound, ratio of real to imaginary part of the forward scattering amplitude, partial wave distribution for proton–proton scattering, MacDowell–Martin bound on B(s), and asymptotics and J-plane structure are covered) and inclusive processes (in which a theoretical framework assuming a finite correlation length: the Feynman–Wilson gas, relation of the Feynman–Wilson gas to a Regge description, and approach to scaling, and a two-component description are covered). (JFP)

3526 DETERMINATION OF STATISTICAL TENSORS IN SEQUENTIAL DECAYS. Kotanski, A.; Sredniawa, B. (Jagellonian Univ., Krakow). Acta Microbiol. Pol., Ser.; B4: No. 4, 521-531(1973).

It is shown how to determine statistical tensors from the angular distributions in the decays where one of the decay products decays in turn. All tensor components may be estimated by this method, even the components of tensors T_M^L with odd L(e.g., Im ρ_{10} for spin-1 particles) which cannot be measured by the usual method of moments. In addition, the decay amplitudes can be found if there are more than one coupling constants, like for spin-2 particles. Examples of decays of particles with the following spins are discussed: $1^+ \to 0^+ + (1^- \to 0 + 0)$, $2^- \to 0^- + (1^- \to 0 + 0)$, $3/2^- \to 0^- + (3/2^+ \to 1/2 + 0)$, $2^- \to 0^- + (2^+ \to 0 + 0)$ and $1^+ \to 0^- + (2^+ \to 0 + 0)$. (auth)

3527 CLOTHING TRANSFORMATION IN THE LEE MODEL. Dillon, G.; Giannini, M. M. (Univ., Genoa). Nuovo Cim.; 18A: No. 1, 31-47(1 Nov 1973).

The V-Nθ sector of the Lee model with Galilean invariance is studied by making use of the clothing transformation technique. The most general unitary clothing transformation in the sector is constructed by representing it in the basis of the bare states and it is found that a simple condition must be satisfied by the transformation functions in order to obtain a good potential description for the Nθ interaction. It turns out that if the Hamiltonian has at least one proper eigenstate such a transformation is always possible. Furthermore it is shown that in the limit of infinite coupling constant and infinite internal energy of the V-particle the potential goes to a well-defined form, which yields the limit of the scattering T-matrix, while at the same time the "clothed" states become the bare ones. In particular the "bound-state limit" ($Z \to 0$) is obtained in a natural way. (auth)

3528 SUM RULES FOR INELASTIC FUNCTIONS FROM THE UNITARIZATION OF VENEZIANO PARTIAL-WAVE AMPLITUDES. Chen, C.K. (51-19 97th Street, Corona, New York 11368). Phys. Rev. D 8: No. 3, 899-904 (1 Aug 1973).

Veneziano partial-wave amplitudes are unitarized by the truncated N/D method. The N functions are extrapolated directly from the Veneziano partial-wave amplitudes. Sum rules for inelastic functions are derived from the assumption that the spectrum and the residues of the resonances in the Veneziano model are preserved. Solving these sum rules, the behavior of inelastic functions and the inelastic widths of the resonances can be estimated given a single elastic scattering amplitude of the Veneziano model. An explicit application of this method to the $\pi\pi$ I=1 p-wave amplitude is given. (auth)

3529 PHENOMENOLOGICAL MODEL FOR DIFFRACTIVE EXCITATION OF HADRON RESONANCES. Ravndal, F. (California Institute of Technology, Pasadena, California 91109). Phys. Rev. D 8: No. 3, 847-859 (1 Aug 1973).

In order to describe diffractive excitation of hadrons, a vector–vector form for the imaginary amplitude is proposed. The vector transition operator is related to the ordinary vector current. This description gives approximate s-channel helicity conservation in elastic πN scattering and a differential cross section for elastic NN scattering proportional to the fourth power of the magnetic form factor of the nucleon. All inelastic cross sections for excitation of hadron resonances should dip in the very near forward direction. Calculating the matrix elements of the diffractive transition operator in a relativistic quark model with essentially no free parameters, we get quantitative results which are not in obvious disagreement with experiment for most nucleon and pion resonances. (auth)

3530 STRONG INTERACTIONS AT LARGE TRANSVERSE MOMENTUM. Landshoff, P.V.; Polkinghorne, J.C. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge, England). Phys. Rev. D 8: No. 3, 927-934 (1 Aug 1973).

The models of Blankenbecler, Brodsky, and Gunion for inclusive and exclusive reactions at large transverse momentum are examined in a covariant framework. The discussion of inclusive reactions is much less model-dependent than that of exclusive reactions, but it is argued that for both the rather specific assumptions of Blankenbecler, Brodsky, and Gunion should probably be relaxed. One can argue that, for inclusive reactions, there may be a connection between the power-law falloff in transverse momentum and the behavior of the structure functions for electroproduction and electron–positron annihilation at $\omega=1$ and $\omega=0$. The relation of large transverse-momentum inclusive amplitudes to Regge amplitudes at small transverse momentum is also discussed. For the exclusive process it is shown that a more detailed calculation suggests that the angular dependence is different from that calculated by Blankenbecler, Brodsky, and Gunion. (auth)

3531 RAPIDITY CLUSTERINGS IN HADRONIC PRODUCTION. Tan, C. (Department of Physics, Brown University, Providence, Rhode Island 02912). Phys. Rev. D 8: No. 3, 935-945 (1 Aug 1973).

We elaborate on the role of secondary Regge singularities in the framework of the short-range correlation picture of hadronic production. Their presence is seen to imply the existence of "local clusterings" in the rapidity distributions of events with a fixed multiplicity. In this scheme, the approach to the scaling limit in the central region is a manifestation of the "threshold" effect of "cluster" formation. An explicit model is constructed where the scaling limit can be approached from below. This is then explained from the point of view of Markovian walk in one dimension. (auth)

3532 MULTIPARTICLE PRODUCTION IN THE CENTRAL REGION. Kang, J.S. (Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11790); Ta-chung, M. Phys. Rev. D 8: No. 3, 833-839 (1 Aug 1973).

The mechanism of multiparticle production in the central region is discussed in the framework of the independent-emission picture and in that of the fragmentation picture. It is argued that the study of a certain moment ratio and distribution ratio may be helpful to differentiate these two pictures. The intersecting-storage-rings multi-γ experiment of the Brookhaven–Roma Collaboration is discussed in this connection. In order to illustrate some general features of the fragmentation picture, the model recently proposed by Chou and Yang for charge transfer is applied to the multi-γ production process. (auth)

3533 UNITARY MULTIPERIPHERAL MODELS. II. Sugar, R.L. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. D 8: No. 4, 1134-1143 (15 Aug 1973).

A new class of multiperipheral-like models is presented for which the full multiparticle S matrix is unitary. As in previous models of this type it is crucial for s-channel unitarity that one take into account the exchange of an arbitrary number of multiperipheral chains between the two leading particles. The new features of the present models are that multichain forces and some low subenergy effects are taken into account. As in earlier unitary models, the elastic scattering amplitude has a dynamical branch cut in the angular momentum plane that plays a crucial role in enforcing the Froissart bound. It is shown that the qualitative features of these models will be present in a wide class of multiperipheral-like models. (auth)

3534 MODEL CALCULATION OF CORRELATIONS AT HIGH ENERGY. Finkelstein, J. (Department of Physics, Columbia University, New York, New York 10027). Phys. Rev. D 8: No. 3, 977-980 (1 Aug 1973).

The inclusive two-body correlation function for particles produced in high-energy hadronic collisions is calculated in a multiperipheral-like model, and compared with experiment. (auth)

3535 RECOUPLING DIAGRAMS FOR DUALITY. Canning, G.P. (Instituut voor Theoretische Fysica, Universiteit Leuven, Celestijnenlaan, 200D, B-3030 Heverlee, Belgium). Phys. Rev. D 8: No. 4, 1151-1156 (15 Aug 1973).

We show how duality diagrams may be rigorously formulated in terms of recoupling diagrams. This allows us to write down in closed form general solutions to the constraints imposed by duality and the absence of exotic resonances, and to give for the first time in closed form general expressions for the coupling constants in terms of the quark-hadron recoupling coefficients which are given by the 6j-like symbols of the appropriate group. We note the connection with the internal-symmetry factors given by the trace of a product of matrices, and we further note that SU(n) is not determined by the above constraints. (auth)

3536 CURRENT AND CONSTITUENT QUARKS IN THE LIGHT-CONE QUANTIZATION. Eichten, E. (Department of Physics, Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Feinberg, F.; Willemsen, J.F. Phys. Rev. D 8: No. 4, 1204-1219 (15 Aug 1973).

Using the light-cone quantization of the free-quark model, a wide class of unitary transformations which relate the "current" to the "constituent" quark models is constructed. The Melosh transformation is obtained as a special case. The construction clearly exhibits the kinematical aspects of the transformation. Phenomenological applications are discussed. A method for determining acceptable transformations in potential models is formulated. (auth)

3537 APPROACH TO A COMPLETE BOOTSTRAP. Rosenblit, M. (Department of Physics and Astronomy, Tel Aviv University, Ramat Aviv, Israel). Phys. Rev. D 8: No. 4, 1185-1189 (15 Aug 1973).

It is shown in a simple model of quarks and mesons with Yukawa coupling that consistency conditions determine all dimensionless parameters of the model. Similar results are discussed for models also containing baryons (bound states of three quarks) and SU(3) symmetry. We use the static limit of the ladder approximation. (auth)

3538 TREATMENT OF OVERLAPPING RESONANCES IN 3-BODY SYSTEMS AND THE GENERALIZATION OF THE ISOBAR APPROXIMATION. Gustafson, G. (Univ. of Lund, Sweden). Nucl. Phys.; B63: 325-348(1973).

An essential problem when making an isobar approximation in the case of overlapping resonances is the fact that diagrams which contain one particle exchange processes, as e.g. nucleon exchange in the $\pi\Delta$ system, give singularities above the physical threshold and a complicated dependence of the S-matrix on the total energy and the sub-energies. In this paper these singularities are treated explicitly in a manner which is inspired by Faddeev theory. Resonance-particle scattering amplitudes are defined in a consistent way which fulfils 3-particle unitarity exactly. These amplitudes can be calculated using dispersion relations or the N/D method. An important result is that the exchange diagram corresponding to the so-called Peierls mechanism should not be regarded as a driving force. It influences the result through a slight change of the resonance particle phase space. An application to the $\pi\Delta$ system will be presented in a subsequent paper. (auth)

3539 NEW GHOST-FREE DUAL MODELS. Gervais, J. L. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France); Neveu, A. Nucl. Phys.; B63: 127-140(1973).

The possibility of building ghost-free dual resonance models with a leading intercept α_0 smaller than one is investigated. In the framework of the conventional model, the usual vertex is modified, multiplying it by a function Q of the Virasoro operators L_{-n}. This function Q is to be determined in such a way that the Virasoro ghost-killing gauge conditions hold. Although the problem could be solved in closed form only in particular cases, the method works in general for any intercept $\alpha_0 < 1$ and any critical space-time dimension $D \leq 25$. (auth)

3540 CANCELLATION OF THE LEADING DIVERGENCE IN DUAL LOOPS. Green, M. B. (CERN, Geneva). Phys. Lett.; 46B: No. 3, 382-396(1 Oct 1973).

It is shown that the leading divergence of the single meson loop of the dual pion model is cancelled by a similar divergence of the fermion loop in the model with no ghosts. There is still one remaining divergence at the one-loop level. (auth)

3541 MAGNETIC FLUX LINES AS RELATIVISTIC STRINGS. Tassie, L. J. (Australian National Univ., Canberra). Phys. Lett.; 46B: No. 3, 397-398(1 Oct 1973).

It is suggested that the relativistic string of the dual resonance model of hadrons is a line of quantized magnetic flux. Accordingly, quarks have magnetic charge. Assuming quarks of magnetic charge +g, −2g, baryons are composed of three quarks. States of one, two, four or five quarks will not normally occur. (auth)

3542 RAPIDITY CORRELATIONS IN PARTICLE PRODUCTION AT THE ISR INTERPRETED BY INDEPENDENT EMISSION OF CLUSTERS. Schmidt-Parzefall, W. (CERN, Geneva). Phys. Lett., 46B: No. 3, 399-402(1 Oct 1973).

The magnitude and range of two particle correlations in the central rapidity plateau region are calculated under the assumption that independent emission of clusters and their subsequent decay is the dominant origin of rapidity correlations. Consistency with the data is achieved with clusters decaying into a mean number of 3.0 pions. For rising c.m. energy the average cluster size approaches a limit. (auth)

3543 MANIFESTLY DUAL FORMULATION OF THE RAMOND MODEL. Mandelstam, S. (Univ. of California, Berkeley). Phys. Lett.; 46B: No. 3, 447-451(1 Oct 1973).

The interacting-string formalism is extended to the Neveu-Schwarz and Ramond models. The duality properties of the latter model are more transparent than in the older formulation, and ghost-free amplitudes with an arbitrary number of external fermions can be calculated. (auth)

3544 NUCLEAR MOTION CORRECTION TO EXOTIC ATOM LEVEL WIDTHS. Leon, M. (Los Alamos Scientific Lab., NM); Seki, R. Phys. Lett.; 46B: No. 3, 299-300(1 Oct 1973).

The effect of nuclear motion on exotic atom radiation rates is discussed. The inclusion of this effect is essential if nuclear absorption rates are to be derived from experimental x-ray yields. (auth)

3545 REGGE POLE MODEL AND HADRON PHYSICS. Hara, Y. (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto), Suppl.; No. 51, 96-228(May 1973).

The Regge pole model of hadron physics is surveyed. Kinematical properties of helicity amplitudes (symmetry properties, crossing relations and analyticity properties), Reggeization of helicity amplitudes, the MacDowell symmetry and the factorization of Regge residues are discussed. Also the Pomeron, the vector- and tensor-trajectories, and the pseudoscalar trajectories are studied. Inclusive reactions in the Regge pole model are briefly discussed. (auth)

3546 CHIRAL SYMMETRY BREAKING AND MESON DECAYS IN A RELATIVISTIC QUARK MODEL. Rein, D. (Technische Hochschule, Aachen). Z. Phys.; 259: No. 3, 205-216(1973).

Applying two different Lorentz-covariant quark models, one of them being essentially nonrelativistic, chiral symmetry breaking parameters of strong interaction are calculated. Also attention is paid to meson decays. The model retaining relativistic spinor structure for quark-antiquark wave functions turns out to be more appropriate than the nonrelativistic one. (GE)

Strong (Baryon No. = 0)

3547 (BNL-18271) PREDICTING K^{*0} AND $\bar{K}^{*0}$ PRODUCTION FROM ρ^0 AND ω^0 PRODUCTION. Field, R. D. (Brookhaven National Lab., Upton, N. Y. (USA)). Sep 1973. 28p. (CONF-730837-5). Dep. NTIS $3.50.

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973).

Interesting lessons learned from detailed Regge pole plus absorption model fits to ρ^0 and ω^0 production are outlined. Emphasis is placed on the behavior of the resulting amplitudes. These amplitudes are combined to predict the amplitudes and hence the observables for K^{*0} and $\bar{K}^{*0}$ production. The reactions π + N are primarily discussed. (JFP)

3548 (COO-1428-330) ρ^0 PRODUCTION DENSITY MATRIX ELEMENTS, PHASE COHERENCE AND SMOOTHNESS OF THE BALL AMPLITUDES. Gutay, L. J.; Vasavada, K. V. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Physics). 1973. Contract AT(11-1)-1428. 12p. Dep. NTIS $3.00.

The experimental observation that ${}^t\rho^1_{-1} \approx 0$ in an extended range of s and t in $\pi^- p \to \rho^0 n$ imposes strong constraints on the helicity amplitudes. The Ball invariant amplitudes satisfy these constraints only if $B_1 \approx -B_2$. The last condition, with the smoothness assumption, causes $H^1_{\frac{1}{2}} - H^{-1}_{\frac{1}{2}}$ to vanish at $t \approx -\mu^2$. This results in a zero of $\mathrm{Re}\,{}^t\rho^1_0$ at $t \approx -\mu^2$ which is clearly not due to phase incoherence as claimed in a recent amplitude analysis. (auth)

3549 (JINR-P1-7155) DETERMINATION OF STATISTICAL SIGNIFICANCE IN EXPERIMENTS ON DETECTION OF NEW RESONANCES. Vinogradov, V. B.; Dokhtmanov, M. E.; Odintsov, V. G.; Pazman, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The problem of statistical significance in experimental detection of new resonances in high energy physics is studied. The formula is derived for determination of statistical fluctuation probability as the measure of statistical significance of the effect observed (histogram peak). Numerical values of probabilities are obtained for practically interesting cases and the statistical significance of 20 experiments is analyzed, which prove, for the first time, the existence of new resonances. (auth)

3550 EXOTICITY AND PHASE CONSISTENCY. Shafee, S.; Shafee, A. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 8: No. 6, 383-387(6 Oct 1973).

It is investigated whether it is sensible to discriminate even theoretically between the possibilities of a) high mass exotic resonances and b) the complete absence of any. In other words it is examined if b) is only a limit of case a) as the lowest mass of these resonances is pushed up to infinity. The Veneziano model is considered, and then a generalization is made to any amplitude with pure Regge pole asymptotic behavior. The asymptotic phase is made the criterion between a) and b). (JFP)

3551 POSSIBLE BORN AMPLITUDE FOR PIONS. Frampton, P. H. (CERN, Geneva). Lett. Nuovo Cim.; 8: No. 8, 525-530 (20 Oct 1973).

A method of classifying Born amplitudes making use of the symmetric group was previously developed, which led to an expression for general four-meson amplitudes. A possible generalization to multipion amplitudes $N \geq 4$ is proposed. (LBS)

3552 MAXIMUM BEHAVIOR OF REGGE TRAJECTORIES AT INFINITY. Fleming, H. (Instituto de Física, C.P. 8219, University of São Paulo, São Paulo, Brasil). Phys. Rev. D 8: No. 4, 1256-1257 (15 Aug 1973).

Conditions are stated under which it is possible to prove that a mesonic Regge trajectory does not grow faster than linearly in s. Comments on an analogous result by Childers suggest that at some points his proof should be made more complete. (auth)

3553 CROSSING SYMMETRY AND LOW-ENERGY PION-PION DYNAMICS. Dilley, J. (Department of Physics, Ohio University, Athens, Ohio 45701). Phys. Rev. D 8: No. 3, 905-920 (1 Aug 1973).

Direct use of crossing symmetry is made to construct the s- and p-wave amplitudes in the region $0 \leq s \leq 4$ from the absorptive parts. The amplitudes constructed in this way are unique except for a single parameter, which itself is determined by unitarity; the resulting s-wave amplitudes then automatically have subthreshold zeros of the current-algebra type. When continued to the physical region by the N/D method, the p-wave produces a dynamical ρ meson without Castillejo-Dalitz-Dyson (CDD) poles. The $I = 2$ s-wave phase shifts agree well with experiment, and the $I = 0$ phase shifts, though subject to more uncertainty, also are consistent with experiment. A comparison is made with other s-wave results in the region $0 \leq s \leq 4$. (auth)

3554 GENERAL FEATURES OF LOW ENERGY Kπ SCATTERING FROM PHYSICAL REGION METHOD. Ader, J. P. (Laboratoire de Physique Theorique, Bordeaux); Meyers, C.; Bonnier, B. Phys. Lett.; 46B: No. 3, 403-406(1 Oct 1973).

A dispersive method is derived valid for low energy Kπ scattering which allows one to analyze the implications of crossing, unitarity and K^* existence. To provide accurate predictions for the s waves, this framework would have to be supplemented by other information. (auth)

3555 ANALYSIS OF THE PROCESSES $\bar{N}N \to 3\pi$, $\bar{p}p \to \eta\pi^+\pi^-$, AND $\bar{p}p \to \omega\pi^+\pi^-$ AS A TEST OF DUAL FOUR POINT-FUNCTION WITHOUT PARITY DOUBLETS. Franzen, G.; Roemer, H (Univ., Bonn). Z. Phys.; 259: No. 3, 227-244(1973).

The five annihilation processes at rest: $(\bar{p})n \to \pi^+\pi^-\pi^-$, $(\bar{p})p \to \pi^0\pi^+\pi^-$, $(\bar{p})p \to 3\pi^0$, $(\bar{p})p \to \eta\pi^+\pi^-$ and $(\bar{p})p \to \omega\pi^+\pi^-$ are simultaneously analyzed by means of a dual quark-symmetric four-point-function without parity doublets. The qualitative features of the mass-spectra are reproduced without free parameters. Predictions for $(\bar{p})p \to 3\pi^0$ are made and compared with the results of Lovelace's model. In connection with the calculation of the ratios of rates the problem of the mass extrapolation for the external particles is discussed. The $\rho-\epsilon$ puzzle turns out to be a key problem for the processes under consideration. (GE)

3556 SCHEME OF CLASSIFICATION AND COUPLING OF HADRON RESONANCES. Mitra, A. N. (Univ. of Delhi). J. Sci. Ind. Res.; 31: No. 9, 460-461(Sep 1972).

A broad framework for classification and coupling of hadron resonances (in the limit of low momentum transfers) with a minimal number of parameters is put forward along with a brief mention of the essential foundations of the subject of resonance physics. This framework still retains sufficient flexibility to facilitate modifications in the parametric structures to suit the needs of experiment. A relativistic extension is necessary for application of this model to physical situations involving high energies. A short account of some of the previous investigations on these lines is mentioned. It is found that a construction on this model is possible at the phenomenological level, so as to conform to certain broad principles, such as symmetry in the moments associated with the two baryon legs and universal values of the reduced coupling constants for successive Regge recurrences of a given resonance. In this way, the number of independent coupling constants (reduced) can be brought down to as few as two, while the rest of the coupling structure is specified in terms of the dynamical variables of the system. The above scheme has a wide range of applications—from the evaluation of decay properties of resonances which bear on the on-shell structures of the vertices, to the prediction of scattering and production amplitudes for a large class of meson-baryon-photon processes. (KB)

Strong (Baryon No. = 1)

Refer also to abstracts 3255 and 3631.

3557 MULTIPLICITY OF NEUTRAL PIONS IN HIGH ENERGY COLLISIONS. Bardadin-Otwinowska, M.; Bialkowska, H.; Gajewski, J.; Gokieli, R.; Otwinowski, S.; Wojcik, W. (Univ., Warsaw). Acta Microbiol. Pol., Ser.; B4: No. 4, 561-571(1973).

The experimental characteristics of the π^0 production in high energy π^-p and pp collisions were studied. The observed features of charged multiplicity distribution and neutral pion production are described by a phenomenological model which assumes a Czyżewski–Rybicki formula for the total multiplicity distribution and the hypothesis of isospin independence. (auth)

3558 ASYMPTOTIC PROPERTIES OF CHARGE DISTRIBUTIONS. Berceanu, S.; Beslin, T.; Gheorghe, A.; Mihul, A. L. M. (Joint Inst. for Nuclear Research, Dubna). Lett. Nuovo Cim.; 8: No. 6, 345-352(6 Oct 1973).

Some asymptotic properties of the charge distributions suggested previously are presented for $\pi^+ + p$ and $\pi^- + p$ interactions at 6 to 22 GeV/c and $p + p$ interactions at 24 to 1500 GeV/c. Using constraints imposed by the laws of energy and charge conservation and certain model-independent assumptions, it is established that the invariant charge distributions approach a zero limiting value in the central region and satisfy several Pomeranchuk properties in the fragmentation domains. It is also shown that these properties imply the vanishing of any charge exchange cross section and a separate charge conservation in both the cm hemispheres when the incident energies go to infinity. (JFP)

3559 MULTIPLICITY OF SECONDARY PRODUCTION IN HIGH ENERGY INTERACTIONS. Sitte, K. (Univ., Freiburg i. B.); Dardo, M. Nuovo Cim.; 18A: No. 1, 151-166(1 Nov 1973).

A fireball model is proposed in which hadronic interactions are described by a sequence of two processes. In the first the nucleon or nucleons absorb the entire available energy, forming an excited body or bodies. The second consists of the decay of this body with emission of the nucleon in its initial direction. For nucleon-nucleon collisions this leads immediately to an asymptotic $E_{1/4}$ multiplicity relation. But for hadronic interactions of pions, photons, and muons an $E_{1/2}$ multiplicity law is obtained. The calculated average numbers of secondaries are in satisfactory agreement with present data on N-N and π-N interactions. Applied to a description of the longitudinal development of an air shower the model predicts a location of the cascade maximum only slightly deeper than that found if an $E_{1/4}$ multiplicity relation is assumed for both N-N and π-N collisions, and distinctly higher than that derived for an $E_{1/2}$ law in both types of interaction. Thus it makes unnecessary the assumption, suggested by several authors in their analysis of air showers, that the characteristics of hadronic interactions undergo a drastic change at high primary energies. (auth)

3560 $K^-\pi^-$ INTERACTION FROM K^-p DATA AT 8.25 GeV/c. Athens-Democritus-Liverpool-Vienna Collaboration. Nucl. Phys.; B63: 211-228(1973).

Total and elastic cross sections were obtained for the $I = 3/2$ $K^-\pi^-$ system as a function of $K^-\pi^-$ mass by performing a one-pion-exchange analysis on K^-p interactions at 8.25 GeV/c; the results indicate that the interaction becomes rapidly inelastic with increasing $K^-\pi^-$ mass. The differential elastic cross sections were also examined, and the data compared with an amplitude containing a Veneziano plus a diffraction term. Good overall agreement was achieved. (auth)

3561 PADE APPROXIMATION OF THE NUCLEON PROPAGATOR AND THE CALCULATION OF THE $N^*(I = \frac{1}{2}, J = \frac{1}{2}\pm)$ RESONANCES. Jacobs, D.; Lambert, F. (Vrije Univ., Brussels). Nucl. Phys.; B63: 477-498(1973).

The method of Padé Approximants (P.A.) is applied to the nucleon propagator in the Yukawa-model, for calculating excited states of the nucleon with the same quantum numbers as the nucleon, except parity. The [1,1] P.A. of the propagator is constructed from perturbative contributions to the mass-operator up to the fourth-order in the renormalized πN coupling constant. The elastic contributions are calculated analytically and expressed in terms of di- and tri-logarithms. The inelastic contributions are evaluated in the approximation in which the three-body imaginary parts are taken at zero pion-mass ($\mu = 0$). A resonance equation is numerically solved on the real axis yielding resonance candidates for the S_{11}- and P_{11}-waves. (auth)

3562 π EXCHANGE, Δ PRODUCTION, AND MESON–MESON SCATTERING. Irving, A. C. (CERN, Geneva). Nucl. Phys.; B63: 499-512(1973).

A method of extracting amplitude components from charge exchange processes of the form $0^-N \rightarrow 0^-0^-\Delta$ or $0^-N \rightarrow 1^-\Delta$ by using the full decay distributions. The processes $\pi^+p \rightarrow \rho^0\Delta^{++}$ $\omega\Delta^{++}$ are analyzed as a simple application and some properties of π and B exchange are discussed. The suitability of the method for extraction of meson-meson scattering amplitudes is emphasized. (auth)

3563 REGGE ANALYSIS OF CORRELATIONS IN THE CENTRAL PLATEAU. Amann, R. F.; Geer, K. (Syracuse Univ., NY). Lett. Nuovo Cim.; 8: No. 7, 417-420(13 Oct 1973).

A detailed Regge analysis with P, ρ, and f trajectories is made of correlations in the central plateau for $\pi + p$ and $p + p$ interactions. (JFP)

3564 EXPERIMENTAL INVESTIGATION ON THE KOBA, NIELSEN, AND OLESEN SCALING LAW AT LOW ENERGY AND ITS VALIDITY FOR DEFINITE RAPIDITY INTERVALS. Antich, P. (Univ., Pavia, Italy); Calligarichi, E.; Cecchet, G.; Dolfini, R.; Impellizzeri, F.; Ratti, S.; Liotta, L. Lett. Nuovo Cim.; 8: No. 7, 449-457(13 Oct 1973).

The reactions $\pi^- + p$ and $p + p$ between 4 and 25 GeV/c were studied to check the validity of the KNO scaling law down to energies $\sqrt{s}$ as small as 3 GeV for different projectiles and to investigate its possible validity for exclusive reactions in a priori definite rapidity intervals. (JFP)

3565 DYNAMICS OF THE $\pi\Delta$ SYSTEM AND THE πN RESONANCES $D_{15}(1670)$ AND $S_{11}(1535)$. Gustafson, G. (Univ. of Lund, Sweden). Nucl. Phys.; B63: 349-363(1973).

The interaction in the $\pi\Delta$ system is studied and it is shown that ρ-exchange is expected to give strong attraction in the partial waves P_{11}, D_{15}, D_{13} and D_{11} (the last of which couples to πN S_{11}). It gives an explanation of the resonances $D_{15}(1670)$ and $S_{11}(1535)$ and it may combine with the interaction in the πN and ρN systems to produce $D_{13}(1520)$ and $D_{13}(1700)$ and in the ϵN system to produce $P_{11}(1470)$. The N/D method is used to calculate the πN elastic amplitude for the first two cases and good agreement is obtained with phase shift analyses if it is assumed that the coupling between the πN and $\pi\Delta$ systems is dominated by nucleon exchange. Taken together with an earlier analyses of the ρN system, an explanation of all πN resonances below 2 GeV is obtained in terms of strong attraction in the πN or $\pi\pi N$ systems. (auth)

3566 PRODUCTION OF REGGE RECURRENCES. Michael, C. (CERN, Geneva). Nucl. Phys.; B63: 431-444(1973).

For resonance states lying on a given Regge trajectory, the two-body production mechanism as a function of the excitation of the recurrence state is discussed. A dual resonance model suggests general features for the Regge-Regge-particle coupling involved in such production. An application is made to the high energy production in $\pi N \rightarrow \pi\pi N$ of ρ, f_0 and g mesons with emphasis on the relative production cross sections, the relative t-dependences, the ratio of natural to unnatural parity exchange and the helicity dependence. (auth)

3567 BREAKDOWN OF SCALING DUE TO THE POSSIBLE STRUCTURE OF NUCLEONIC CONSTITUENTS. Pavkovic, M. (New York Univ., NY). Phys. Lett.; 46B: No. 3, 435-438(1 Oct 1973).

Aside from relativistic quark model representations which correspond to the picture of point-like quarks, the current algebra also allows representations which can be interpreted in terms of quarks with structure. Speculation is made about the possibility that the experimentally observed small deviations from scaling for higher values of q^2 point out the extended nature of nucleon constituents. (auth)

3568 LONG RANGE FORCES IN KN AND $\bar{K}N$ SCATTERING. Hedegaard-Jensen, N.; Nielsen, H.; Oades, G. C. (Univ. of Aarhus, Denmark). Phys. Lett.; 46B: No. 3, 385-388(1 Oct 1973).

The long range forces in KN and $\bar{K}N$ scattering are calculated, and it is shown how they can be used to provide consistent predictions of many experimental results. In particular, the existence of a Z_0^* resonance near 1700 MeV/c^2 is strongly favored. (auth)

Strong (Baryon No. $\geq$ 2)

Refer also to abstracts 3635, 3691, and 3801.

3569 (COO-1112-139) ENERGY DEPENDENCE OF CHARGED PARTICLE MULTIPLICITY. Rai Choudhury, S. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). 1972. 9p. Dep. NTIS $3.00.

The energy dependence of the inclusive cross sections in the central region is used to predict the energy dependence of the charged particle cross sections in high energy hadron collisions. (auth)

3570 (COO-1112-169) ENERGY DEPENDENCE OF MEAN SQUARE CHARGED MULTIPLICITY IN REGGE–MUELLER FORMALISM. Rai Choudhury, S.; Majumdar, D. P. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). 1972. 21p. Dep. NTIS $3.25.

The energy dependence of the mean square multiplicity $\langle n^2 \rangle$ is obtained on the basis of a Regge–Mueller analysis, when a Pomeron with $\alpha_p(0) = 1$ and subsidiary trajectories with $\alpha_{p'}(0) = \frac{1}{2}$ are present. The expression for $\langle n(n-1) \rangle$ is shown to be of the form $c_1 (\ln s)^2 + c_2 (\ln s) + c_3 + c_4 [(\ln s)^2/\sqrt{s}] + c_5 (\ln s/\sqrt{s}) + (c_6/\sqrt{s})$, with the coefficients given in terms of certain well defined integrals over physically measurable quantities. It is found that c_1 and c_4 must be positive. It is discussed how the sign of c_2 can be negative to account for the present experimental data. From a knowledge of a similar expression for the mean multiplicity $\langle n \rangle$, plausible numerical estimates of the coefficients c_1 and c_2 are obtained. These two coefficients alone reproduce reasonably well the $\langle n_{ch} (n_{ch}-1) \rangle$ experimental data in p-p collisions up to a constant term. (auth)

3571 (COO-1428-331) RAPID MULTIPLICITY RISE AS FUNCTION OF MOMENTUM TRANSFER IN MULTICOMPONENT MODELS. Gutay, L. J.; Suranyi, P. (Brookhaven National Lab., Upton, N. Y. (USA); Cincinnati Univ., Ohio (USA)). 1973. 12p. Dep. NTIS $3.00.

It is shown that the average multiplicity exhibits a rapid rise as a function of t (the momentum transfer between the initial and leading particle) in multicomponent models in marked contrast to multiperipheral models where a slow decrease is predicted. (auth)

3572 (JINR-P2-7220) ANALYSIS OF THE HIGH-ENERGY BEHAVIOR OF THE TOTAL CROSS SECTION AND THE SLOPE PARAMETER OF pp SCATTERING DIFFRACTION PEAK IN THE QUASIPOTENTIAL APPROACH. Goloskokov, S. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 21p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

In the framework of quasipotential approach an analysis is made of high energy behavior of the total cross section and the slope parameter of diffraction peak of pp scattering at $s \gtrsim 15$ $(\mathrm{GeV}/c)^2$. It is shown that σ_{tot}^{pp} and B^{pp} can both increase indefinitely and tend from below to the constant asymptotic limit $s \rightarrow \infty$. (auth)

3573 (JINR-P2-7293) CONTRIBUTION OF THE DEUTERON D STATE IN THE pd → ppn REACTION AT $T_p = 600$ MeV. Golovin, B. M.; Kul'dzhanov, I. K.; Lykasov, G. I.; Khamraev, F. Sh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

It is shown that taking into account of the deuteron D-state in the pd → ppn reaction at $T_p = 600$ MeV strongly changes the quantitative ratio between the single and double scattering contributions to the amplitude of the process considered. However, the conclusion about necessity of taking into account the rescattering effects in the pd → ppn reaction is valid also when considering the D-wave part of the deuteron function. In this case the polarization parameters change considerably their values (even their sign). (auth)

3574 (LBL-2066) DIFFRACTION DISSOCIATION, PION EXCHANGE, AND DIP STRUCTURES IN $p + p \rightarrow X + p$. Bishari, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 3 Jul 1973. Contract W-7405-eng-48. Dep. NTIS $4.00.

A recent NAL experiment, by Sannes et al., on charge exchange dissociation of the proton, namely $p + n \rightarrow X + p$, is shown to be crucial for the understanding of the structure of the diffractive inclusive process $p + p \rightarrow X + p$. It is anticipated that the shallow dip observed in $p + p \rightarrow X + p$ (at $X \approx 0.87$ and $t \approx -0.2$ GeV^2) will considerably move toward $x = 1$ for $|t|$ comparable with the pion mass squared (e.g., $t \approx -0.03$ GeV^2). The implications for a recent NAL experiment, at very small $|t|$ values, by Childress et al, are pointed out. The importance of the dip structure in $p + p \rightarrow X + p$ for the high mass diffraction dissociation mechanism is also discussed. (auth)

3575 (ORO-3992-141) DIFFRACTIVE AMPLITUDE WITH RISING TOTAL CROSS SECTION. Chiu, C. B.; Gleiser, R. J.; Wang, K. H. (Texas Univ., Austin (USA). Center for Particle Theory). Aug 1973. Contract AT(40-1)-3992. 31p. (CPT-34). Dep. NTIS $3.75.

A simple parameterization for high energy diffractive amplitude based on an absorbed multiperipheral model and the unitarity relation is proposed. This parameterization gives an eventual $\sim(\ln s)^2$ growth for the total cross section and a $\sim \ln s$ growth for the average multiplicity. This amplitude together with Regge pole contribution gives a good fit to the pp elastic scattering data for $p_{\text{Lab}} \gtrsim 10$ GeV/c and $|t| \lesssim 0.8$ GeV^2. (auth)

3576 (ORO-4317-31) DISPERSION-THEORETIC APPROACH TO OFF-SHELL T-MATRICES. Technical Report No. 74-032. Reiner, M. J. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Oct 1973. 15p. Dep. NTIS $3.00.

A dispersion-theoretic formalism is presented for obtaining the off-shell t-matrix, which allows the possibility of working directly from relativistic meson theory, without the necessity of explicitly using a potential. The formalism is illustrated for two simple models of the two-nucleon interaction. (auth)

3577 EVIDENCE FOR STRONG CORRELATIONS IN HIGH ENERGY NON-DIFFRACTIVE MULTIPLE PRODUCTION PROCESSES. Bartke, J.; Zalewska, A.; Zalewski, K. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol.; B4: No. 5, 635-638(1973).

It is pointed out that the recent data on topological cross sections in pp collisions indicate not only the presence of a diffractive component, but also strong correlations in the pionization process itself. (auth)

3578 DIFFRACTIVE DISSOCIATION AS SHADOW SCATTERING. Bialas, A.; Kotanski, A. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B4: No. 5, 659-682(1973).

It is pointed out that if the mechanism of diffractive production of particles is the same as that of elastic scattering, the diffractive dissociation can be calculated as shadow of non-diffractive processes. A general method of calculation is proposed. It uses the technique of the overlap matrix. A specific calculation in uncorrelated jet model is performed. In this calculation the diffractive processes arise as a direct consequence of correlations induced in non-diffractive interactions by energy and momentum conservation. The most important prediction of the model is that the inclusive mass distribution of diffractive dissociation splits into non-scaling part describing the low-mass excitations and the approximately scaling part describing the high-mass excitations. The non-scaling part of the mass spectrum is dominated by single particle production and at large masses behaves as $d\sigma/dM^2 \sim M^{-6}$. The shape of the scaling part of the spectrum in the triple-Regge region is $d\sigma/d\xi = (\xi \log \xi)^{-1}$ where $\xi = M^2/s$. The properties of exclusive diffractive channels are also discussed. (auth)

3579 TWO PHOTON PRODUCTION OF LEPTON PAIRS IN HADRON–HADRON COLLISIONS. Soni, A. (Department of Physics, Columbia University, New York, New York 10027). Phys. Rev. D 8: No. 3, 880-889 (1 Aug 1973).

The cross section for the two–photon exchange production of lepton pairs in hadron–hadron collisions is evaluated here up to the leading order in ln*s* for $s \rightarrow \infty$ holding either M^2 or M^2/s fixed. To take into account elastic as well as inelastic emission of photons from hadrons, the general spectrum of equivalent photons is derived in terms of the structure functions of the hadrons and this spectrum is then used for evaluating the leading ln*s* terms in the two-photon cross section. The lepton mass dependence and the angular distribution of the two–photon process are also discussed. (auth)

3580 REPULSIVE CORES AND SUPPRESSION EFFECTS IN THE $^1S_0\Lambda N$ AND $\Lambda\Lambda$ POTENTIALS. Agrawal, B.B.; Schick, L.H. (Department of Physics and Astronomy, University of Wyoming, Laramie, Wyoming 82070). Phys. Rev. D 8: No. 3, 875-879 (1 Aug 1973).

A two–channel one–boson–exchange potential model is constructed for the $^1S_0$ ΛN and $\Lambda\Lambda$ interactions. In the former, the ΛN scattering length and effective range are calculated as functions of the amount of suppression of the closed ΣN channel, and in the latter, the $\Lambda\Lambda$ scattering length and effective range are calculated as functions of the amount of suppression of the closed ΞN channel. The calculations are carried out with hard–core, soft–core, and zero–core short–range repulsions. When σ–meson exchange is included, a total insensitivity to the core shape results for both interactions and the effect of $\Lambda\Lambda \leftrightarrow \Xi N$ coupling is negligibly small. Without σ–meson exchange, the $\Lambda\Lambda$ scattering length and effective range become very dependent on the amount of ΞN–channel suppression and the type of core used. (auth)

3581 BREMSSTRAHLUNG MODEL CALCULATION OF HIGH–ENERGY NUCLEON–NUCLEON SCATTERING. Moreno, H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8: No. 3, 894-899 (1 Aug 1973).

A model calculation of nucleon–nucleon scattering is presented which results in an amplitude that in the elastic high–energy limit realizes the Wu–Yang idea regarding the relation between the elastic form factor of the nucleon and the differential cross section and which is consistent with the behavior of the differential cross section for the production of nucleon resonances. The calculation makes use of results obtained with the same model in the study of electroproduction. (auth)

3582 RAPIDITY AND ANGULAR DISTRIBUTIONS OF CHARGED SECONDARIES ACCORDING TO THE HYDRODYNAMICAL MODEL OF PARTICLE PRODUCTION. Carruthers, P.; Duong–van, M. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850). Phys. Rev. D 8: No. 3, 859-874 (1 Aug 1973).

Recent measurements of inclusive production cross sections are analyzed in the framework of the Landau hydrodynamical model of particle production. We also give a critical analysis of recent data and the variables used in their presentation. It is concluded that the evidence for a flat rapidity distribution in the central region is not compelling. Except possibly at the very highest available ISR (CERN Intersecting Storage Rings) energy, the Landau Gaussian gives an excellent description of the rapidity distribution of the nonleading charged secondaries. The calculation of distributions in the variable $\eta = -\ln \tan(\theta/2)$ from given rapidity and transverse momentum distributions is worked out in many interesting cases. The Landau rapidity distribution is cast in a universal (energy dependent) scaling law which agrees well with available data. The angle and energy dependence of charged secondaries near 90 ° in the c.m. system in pp collisions agrees well with the theoretical prediction. Finally it is shown that the hydrodynamical model leads to approximate Feynman scaling except for very small values of $x = 2p_{\parallel}/\sqrt{s}$, where large deviations from scaling are predicted. (auth)

3583 NUCLEON–NUCLEON INTERACTION FROM PION–NUCLEON PHASE–SHIFT ANALYSIS. Cottingham, W.N.; Lacombe, M.; Loiseau, B.; Richard, J.M.; Vinh Mau, R. (Division de Physique Théorique, Institut de Physique Nucléaire and Laboratoire de Physique Théorique et Hautes Energies, Paris). Phys. Rev. D 8: No. 3, 800-819 (1 Aug 1973).

The two–pion exchange contributions to nucleon–nucleon forces are calculated from our knowledge of pion–nucleon phase shifts and pion–pion interaction which are used as input into dispersion relations with the subtractions required by Regge asymptotic behavior. At low energies, nucleon–nucleon potentials are derived, which, with the addition of π–meson and ω–meson exchange, explain many features of the phenomenological potentials without any adjustable parameter. However, the calculated spin–orbit and central potentials have significant nonlocal components at small distances. (auth)

3584 TRANSVERSE–MOMENTUM DISTRIBUTION IN INCLUSIVE REACTIONS AND RELATIONSHIP BETWEEN THE DIFFRACTIVE EXCITATION MODEL AND THE THERMODYNAMIC MODEL. Gordon, E.M. (Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403). Phys. Rev. D 8: No. 3, 971-973 (1 Aug 1973).

It is shown that the choice of a Planck distribution for the cluster–decay function in the diffractive excitation model gives good agreement with the inclusive transverse–momentum spectrum of pions in pp collisions. Since this kind of distribution is associated with the thermodynamical model, the relationship between the two models is examined. (auth)

3585 SIMILARITY OF PROPERTIES OF PHOTONS AND PIONS AND PRODUCTION OF PIONS WITH LARGE TRANSVERSE MOMENTA. Dremin, I. M. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 18: No. 3, 617-622(Sep 1973). (In Russian).

Multiperipheral theory is used to describe the spectra of pions produced in high-energy (ISR) pp collisions at the angle of 90° with high transverse momenta. The distributions are reasonably described with no free parameter assuming a similarity of properties of photons and pions off the mass shell. The experimentally observed increase of the spectra with energy and their power-law decrease ($\sim p_{\perp}^{-8}$) at large transverse momenta are reproduced, as well as the absolute pion yield. Limiting form of the spectrum in the high energy asymptotics is predicted. (auth)

3586 UNITARY EIKONAL FORMALISM FOR MULTIPRODUCTION OF ISOVECTOR MESONS AT HIGH ENERGY. Redei, L. B. (CERN, Geneva). Nucl. Phys.; B63: 463-476(1973).

Unitary eikonal models for multiproduction of isovector mesons are discussed in general terms. A closed analytic expression is derived for the partial production cross sections and for the meson multiplicity moments. A simple class of models is discussed in more detail. (auth)

3587 THREE-PARTICLE GROUND STATE: SENSITIVITY TO EQUIVALENT INTERACTIONS. Benayoun, J. J.; Gignoux, C.; Gillespie, J.; Laverne, A. (Institut des Sciences Nucleaires, Grenoble, France). Lett. Nuovo Cim.; 8: No. 7, 414-416(13 Oct 1973).

The sensitivity of a three-particle bound state to the choice among a variety of typical potentials each giving the same low energy scattering parameters and bound state energies is studied. As a simple test of this model dependence of the binding energy of the Λ-d bound system is obtained using the separable Yamaguchi potential for a range of values for the scattering length and effective range. (JFP)

3588 POSSIBLE INTERPRETATION OF PP RISING TOTAL CROSS SECTIONS. Lukaszuk, L.; Nicolescu, B. (Institut de Physique Nucleaire, Paris). Lett. Nuovo Cim.; 8: No. 7, 405-413(13 Oct 1973).

It is shown that the assumption that the rise of pp total cross sections at ISR energies can be understood by the existence of a contribution proportional to $\ln^2 s$ is not necessarily within the existing knowledge of experimental data. Also by assuming that asymptotically Re F ~ s $\ln^2 s$ together with $\sigma_T \sim \ln^2 s$ it is possible to propose a parametrization which seems interesting both from the experimental and theoretical points of view. (JFP)

3589 QUASIPOTENTIAL APPROACH TO LOW ENERGY RELATIVISTIC CORRECTIONS. Bawin, M.; Lavine, J. P. (Univ., Liege). Nucl. Phys.; B63: 513-518(1973).

A simple phenomenological way of estimating the contribution of crossed-ladder graphs to the magnitude of relativistic corrections in low energy nucleon-nucleon scattering is proposed. The approach is based on the Todorov equation, since it is a simple 2-body relativistic wave equation with the right static and eikonal limits. The interaction kernel used is based on the iterated Blankenbecler-Sugar-Logunov-Tavkhelidze equation. Within this model, good agreement is found with some results obtained by Levine and Wright, who include one ladder and one crossed ladder graph in the Bethe-Salpeter equation. For low energy nucleon-nucleon scattering, it is found that the phase shifts differ at most by 20% from those obtained with the Lippmann-Schwinger equation. (auth)

3590 PROCESS $pp \rightarrow ppe^+e^-$ AND THE POSSIBILITY OF ITS CALCULATION BY MEANS OF QUANTUM ELECTRODYNAMICS ONLY. Budnev, V. M.; Ginzburg, I. F.; Meledin, G. V.; Serbo, G. V. (Inst. for Mathematics, Novosibirsk, USSR). Nucl. Phys.; B63: 519-541(1973).

The analysis of the process $pp \rightarrow ppe^+e^-$ at high energies is carried out. It is shown that pure QED only is sufficient for the calculation of the main contribution to the cross section of this process with high accuracy. A qualitative picture of the process is discussed in the main logarithmic approximation. At $\sqrt{s} = 2E = 40$ GeV the total cross section $\sigma = 0.2$ mb; the characteristic energies and angles of e^+, e^- emission are $\epsilon_{\pm} \sim m_e\sqrt{E/m_p}$ and $\theta_{\pm} \sim \sqrt{m_p/E}$ respectively. The differential cross section of the process which is calculated with high accuracy is written as a double integral. The contributions of background processes and possible applications for a calibration of the colliding pp and ep beams' luminosity are discussed. (auth)

3591 PRODUCTION OF HIGH TRANSVERSE MOMENTUM LEPTONS IN HADRONIC COLLISIONS. Lederman, L. M.; Saxon, D. H. (Columbia Univ., New York). Nucl. Phys.; B63: 313-324 (1973).

The production mechanisms of high transverse momentum leptons are reviewed. It is shown that the existence or non-existence of the intermediate vector boson and heavy photon in the observed mass range can be established from single-particle spectra, and μe universality tested at high lepton-antilepton masses. (auth)

3592 MAXIMAL ELECTROMAGNETIC CONTRIBUTION TO pp INELASTIC CROSS SECTIONS AT ISR-ENERGIES. Eilam, G.; Holden, J. P. (McGill Univ., Montreal). Phys. Lett.; 46B: No. 3, 443-446(1 Oct 1973).

The maximal electromagnetic contribution to the pp inelastic cross section is estimated. Although this contribution is insufficient in itself to explain all of the recently observed rise at ISR energies if the purely strong cross section is asymptotically constant, it could amount to as much as approximately 3 mb at $\sqrt{s} \approx 53$ GeV if the purely strong cross section rises with energy through the range of present accelerator energies like $(\ln s)^2$ or slower. (auth)

3593 ENERGY SPECTRA AND POLARIZATION OF PROTONS FROM THE REACTION $pd \rightarrow ppn$ AT THE ENERGY OF 600 MeV. Golovin, B. M.; Lykasov, G. I.; Rozanova, A. M.; Khamraev, F. Sh. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 2, 333-335(Aug 1973). (In Russian).

Results for the energy spectra and polarization of protons from reaction $pd \rightarrow ppn$ at $T_p = 600$ MeV calculated with account of the rescattering are presented. It is shown that in the proton energy spectrum the contributions from the single and double scatterings are separated under certain conditions. Besides, the value of the polarization is found to be very sensible to the shape of the ground state deuteron wave function. (auth)

3594 QUARK MODEL AND INCLUSIVE SPECTRA IN THE CENTRAL REGION $p_{\perp}^{cm}$ ABSOLUTE VALUE $\leq 0.3p_{max}$. Anisovich, V. V.; Kobrinsky, M. N. (Inst. for High Energy Physics, Serpukhov, USSR). Phys. Lett.; 46B: No. 3, 419-422(1 Oct 1973).

It is found that the quark model describes well the experimental data for particle spectra in p + p interactions at high energies. (JFP)

3595 EVIDENCE FOR STRONG CLUSTERING EFFECTS IN HIGH MULTIPLICITY FINAL STATES AT 30 GeV. Hanlon, J. (Vanderbilt Univ., Nashville); Panvini, R.; Ludlam, T.; Slansky, R. Phys. Lett.; 46B: No. 3, 415-418(1 Oct 1973).

A statistical analysis of the event-to-event fluctuations of the longitudinal-momentum distributions is applied to 2-, 3-, 4- and 6-pion production data in 28 GeV/c proton-nucleon collisions, as well as to several models. The results indicate that a dominant feature of these final states is the formation of high multiplicity clusters of particles. (auth)

3596 MODEL INDEPENDENT ANALYSIS OF THE STRUCTURE IN pp SCATTERING. Phillips, R. J. N. (Rutherford Lab., Berkshire, Eng.); Barger, V. Phys. Lett.; 46B: No. 3, 412-414 (1 Oct 1973).

An empirical study of the structure at $t \approx -1.1$ in $d\sigma/dt$ ($pp \rightarrow pp$), in terms of two exponential amplitudes plus interference, gives the following results. The steeper exponential shows standard Regge shrinkage, corresponding to a trajectory $\alpha \approx 1 + 0.3$ t. The other exponential slope stays constant; the overall energy dependence of this amplitude is approximately s^{-1} for 10-30 GeV, leveling off possibly to a constant at ISR. The relative phase is about 2.1 rad at the lower momenta, becoming 2.5 at ISR. These results suggest a simple physical picture, in which a relatively unstructured shrinking Regge amplitude interferes with an even-signature non-Regge background. This interpretation predicts that the interference minimum in $d\sigma/dt$ is deepest at an intermediate momentum near 175 GeV where measurements will soon be made at NAL. (auth)

3597 NONADIABATIC EFFECTS IN HIGH ENERGY SCATTERING OF PARTICLES OFF NUCLEI. Kolybasov, V. M.; Kondratyuk, L. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 2, 316-326(Aug 1973). (In Russian).

Nonadiabatic effects in scattering of high energy particles off nuclei are considered, as well as effects due to the deviation from the geometrical optics. Estimates for arbitrary nuclei are presented, and explicit analytic expressions for the corrections are obtained in the case of the deuteron. Account of these effects enables one to extend the description of the hadron-deuteron scattering, developed for high energy, to the intermediate energy region 0.3 GeV/c $\lesssim k \lesssim$ 1 GeV/c. The predictions are nonvanishing with the energy rise real part ($\sim 10^{-2}$) of the hadron-deuteron scattering amplitude and violation of the Glauber approach at $\Delta^2R/8m \sim 1$, where Δ is the momentum transfer, R is the nuclear radius, m is the nucleon mass. (auth)

3598 HADRONIC PRODUCTION OF MUON PAIRS. Fidler, R. W. (Cambridge Univ., Eng.). Phys. Lett.; 46B: No. 3, 455-458(1 Oct 1973).

The quark parton model predictions for muon pair production processes are reexamined in the light of recent experimental data of the proton and neutron structure functions. (auth)

3599 ENERGY DEPENDENCE OF INCLUSIVE CROSS SECTION OF PARTICLE PRODUCTION IN THE PIONIZATION REGION. Levin, E. M.; Rysin, M. G. (Leningrad Inst. of Nuclear Physics). JETP Lett. (USSR) (Engl. Transl.); 17: No. 12, 465-468(20 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 12, 669-674(20 Jun 1973).

The dependence of the inclusive cross section of the production of pions that are slow in the cms on the colliding-hadron energy is considered. It is shown that the experimentally observed growth of the cross section may be connected with the influence of phase space on the registered particles. Inclusive cross sections and pion distributions for the $p + p \rightarrow \pi^- +$ anything interactions are found. (JFP)

Particle Invariance Principles and Symmetries

General

3600 (ORO-3992-143) GAUGE INVARIANT THEORY OF CP NONINVARIANCE. Hsu, J. P. (Texas Univ., Austin (USA). Center for Particle Theory). Sep 1973. 8p. (CPT-53). Dep. NTIS $3.00.

A renormalizable theory of CP and T violations is discussed. The dynamics of CP violation is completely determined by the principle of minimum gauge invariant interaction. The experimental tests of the theory are also considered. (auth)

3601 EXTENSIONS OF PROJECTIVE REPRESENTATIONS TO UNITARY GROUP REPRESENTATIONS. Jadczyk, A. Z. (Univ., Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 21: No. 6, 581-583(1973).

Sz-Nagy's extension theorem is applied to show that every projective representation of a group G can be obtained by projecting a (true) unitary representation onto a noninvariant cyclic subspace. (auth)

3602 CONFORMAL ALGEBRA IN SPACE-TIME AND OPERATOR PRODUCT EXPANSION. Ferrara, S. (CNEN, Frascati, Italy); Gatto, R.; Grillo, A. F. Springer Tracts Mod. Phys.; 67: 1-64(1973).

The topics discussed are the conformal group in space-time, broken conformal symmetry, restrictions from conformal covariance on equal-time commutators, manifestly conformal covariant structure of space-time, conformal invariant vacuum expectation values, operator products and conformal invariance on the light cone, and consequences of exact conformal symmetry on operator product expansions. (JFP)

3603 FREUDENTHAL'S INNER MULTIPLICITY FORMULA. Kolman, B. (Drexel Univ., Philadelphia); Beck, R. E. Comput. Phys. Commun.; 6: No. 1, 24-29(Jul 1973).

The program FREUD written in FORTRAN IV for the IBM 370/165 computer is described for computing the weight diagram of an irreducible representation ρ of a complex simple Lie algebra. This problem is equivalent to computing the character of ρ. (JFP)

3604 NEW REDEFINITION OF THE INVERSION OPERATORS. Werle, J. (Univ., Warsaw). Acta Phys. Pol.; B4: No. 5, 625-633 (1973).

Following the general idea of a previous paper the operations CP and T are defined in a rigorous manner by their actions on the one- and many-particle basis vectors describing free but physical (dressed) stable particles. It is shown that TCP invariance implies the possibility of a new redefinition of the inversion operators which restores the invariance under the full Poincaré group even if CP and T do not commute with the total Hamiltonian. The rigorous representatives of the space and time inversions have the forms ACP and AT respectively, where A is a suitable unitary operator. (auth)

3605 UNIFIED LEPTON-HADRON SYMMETRY AND A GAUGE THEORY OF THE BASIC INTERACTIONS. Pati, J.C. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland); Salam, A. Phys. Rev. D 8: No. 4, 1240-1251 (15 Aug 1973).

An attempt is made to unify the fundamental hadrons and leptons into a common irreducible representation F of the same symmetry group G and to generate a gauge theory of strong, electromagnetic, and weak interactions. Based on certain constraints from the hadronic side, it is proposed that the group G is $SU(4') \times SU(4'')$, which contains a Han–Nambu–type $SU(3') \times SU(3'')$ group for the hadronic symmetry, and that the representation F is (4, 4*). There exist four possible choices for the lepton number L and accordingly four possible assignments of the hadrons and leptons within the (4, 4*). Two of these require nine Han–Nambu–type quarks, three "charmed" quarks, and the observed quartet of leptons. The other two also require the nine Han–Nambu quarks, plus heavy leptons in addition to observed leptons and only one or no "charmed" quark. One of the above four assignments is found to be suitable to generate a gauge theory of the weak, electromagnetic, and $SU(3'')$ gluonlike strong interactions from a selection of the gauges permitted by the model. The resulting gauge symmetry is $SU(2')_L \times U(1) \times SU(3'')_{L+R}$. The scheme of all three interactions is found to be free from Adler–Bell–Jackiw anomalies. The normal strong interactions arise effectively as a consequence of the strong gauges $SU(3'')_{L+R}$. Masses for the gauge bosons and fermions are generated suitably by a set of 14 complex Higgs fields. The neutral neutrino and $\Delta S = 0$ hadron currents have essentially the same strength in the present model as in other $SU(2)_L \times U(1)$ theories. The mixing of of strong– and weak–gauge bosons (a necessary feature of the model) leads to parity–violating nonleptonic amplitudes, which may be observable depending upon the strength of $SU(3'')$ symmetry breaking. The familiar hadron symmetries such as $SU(3')$ and chiral $SU(3')_L \times SU(3')_R$ are broken only by quark mass terms and by the electromagnetic and weak interactions, not by the strong interactions. The difficulties associated with generating gauge interactions in the remaining three assignments are discussed in Appendix A. Certain remarks are made on the question of proton and quark stability in these three schemes. (auth)

3606 VERIFICATION OF MULTIPLICATIVE RENORMALIZATION OF A MODEL WITH SPONTANEOUSLY BROKEN SYMMETRY. Yao, Y. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. D 8: No. 4, 1257-1260 (15 Aug 1973).

We verify explicitly at the one-loop level the multiplicative-renormalization program, performed in an Abelian gauge model with spontaneously broken symmetry. By utilizing the two-parameter gauge freedom which was introduced in a previous note, the off-, as well as on-mass-shell Green's functions can be made finite after renormalization. (auth)

3607 DUALITY OF A YOUNG DIAGRAM DESCRIBING A REPRESENTATION AND DIMENSIONALITY FORMULAS. Murtaza, G. (Institute of Physics, University of Islamabad, Islamabad, Pakistan); Rashid, M.A. J. Math. Phys. (N.Y.) 14: No. 9, 1196-1198 (Sept 1973).

We discuss the standard dimensionality formulas for irreducible representations of continuous Lie groups SU(n), O(n), and Sp(n). Every Young diagram describes not only an irreducible representation of any of the groups SU(n), O(n), and Sp(n) of dimension n, but it also describes an irreducible representation of the symmetric group S_N, where N is the number of boxes in the diagram. This property of a Young diagram leads to the factorization of the dimensionality formulas for irreducible representations of any of these continuous groups into two factors. One factor which depends upon the dimension n of the group appears as a polynomial (with integral roots) of degree N. If we choose the leading coefficient of this polynomial as unity, the other factor turns out to be just 1/N! times the dimensionality of the associated irreducible representation of the symmetric group on N symbols. The polynomial depends upon the type of the group under study, i.e., whether it is an SU(n) or O(n) or Sp(n). We also give simple recipes to read the dimensionality of the representations of these groups from the Young diagram following our formulas. (auth)

3608 PROJECTION OPERATOR TECHNIQUES FOR COMPACT GROUPS. Shapiro, J.Y. (Department of Physics, Fordham University, Bronx, New York 10458). J. Math. Phys. (N.Y.) 14: No. 9, 1262-1270 (Sept 1973).

Projection operator techniques for reducing the Kronecker product of N irreducible representations of a compact group are developed. Among the results are a generalized Clebsch–Gordan series and generalized Wigner–Eckart theorems. The methods developed here are easily applied to any compact group provided one can (a) compute the matrix elements, between product states, of the projector onto the identity representation, and (b) select a subset of product states such that their projections form a basis for the subspace belonging to the identity representation. For the case of angular momentum projection, methods are given for solving both these problems. (auth)

3609 A THEORY OF SPONTANEOUS T VIOLATION. Lee, T.D. (Department of Physics, Columbia University, New York, New York, 10027). Phys. Rev. D 8: No. 4, 1226-1239 (15 Aug 1973).

A theory of spontaneous T violation is presented. The total Lagrangian is assumed to be invariant under the the time reversal T and a gauge transformation (e.g., the hypercharge gauge), but the physical solutions are not. In addition to the spin–1 gauge field and the known matter fields, in its simplest form the theory consists of two complex spin–0 fields. Through the spontaneous symmetry–breaking mechanism of Goldstone and Higgs, the vacuum expectation values of these two spin–0 fields can be characterized by the shape of a triangle and their quantum fluctuations by its vibrational modes, just like a triangular molecule. T violations can be produced among the known particles through virtual excitations of the vibrational modes of the triangle which has a built–in T–violating phase angle. Examples of both Abelian and non–Abelian gauge groups are discussed. For renormalizable theories, all spontaneously T–violating effects are finite. It is found that at low energy, below the threshold of producing these vibrational quanta, T violation is always quite small. (auth)

3610 CONSTRUCTION OF FACTORIZABLE DUAL AMPLITUDES ON BASIS OF CLASSICAL GROUP REPRESENTATIONS BY FUNCTIONS OF SEVERAL COMPLEX VARIABLES. Manida, S. N.; Franke, V. A. (Leningrad State Univ.). Yadern. Fiz.; 18: No. 3, 623-628(Sep 1973). (In Russian).

A method is presented to construct generalized dual amplitudes as integrals over classical domains in the space of functions of several complex variables. The corresponding classical group is the internal symmetry group. The physical amplitudes are realized on basis of the SU (N,1) groups and have the intercept at $\alpha_0 = 2N$. The operator formalism is constructed explicitly for SU (2,1). (auth)

3611 BARYON SPECTROSCOPY AND REGULARITIES BETWEEN SU_6 AND SU_3 MASS-BREAKING PARAMETERS. Fontannaz, M. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Lett. Nuovo Cim.; 8: No. 7, 471-475(13 Oct 1973).

When meson masses are studied with linear mass formulas a link appears between the breaking of SU(6) and that of SU(3). This correlation was used previously to make a choice among the various I = Y = O mesons, candidates of the 1^{++} nonet. It is pointed out that this correlation exists also for the baryons, and an explanation of this fact is proposed within the frame of the quark model. (JFP)

Applications (Electromagnetic and Weak)

Refer also to abstract 3510.

3612 CONSIDERATION OF THE η-PARTICLE. Kim, J. (Seoul National Univ.). New Phys. (S. Korea); 12: No. 3, 94-97 (Sep 1972). (In Korean).

The current status of the experimental, as well as theoretical, studies on the properties of the η-particle is reviewed. It is suggested that the η-particle may play a crucial role in the electromagnetic interaction similar to the role played by the K-meson in the weak interaction. It is well known that the parity violation was discovered in the K-meson decay. An analogy exists between the properties of the K-meson and the η-particle. It is, therefore, postulated that the violation of charge conjugation may occur in the electromagnetic decay of the η-particle. (TTT)

3613 DIRECT TESTS FOR VIOLATION OF CP INVARIANCE. Casella, R.C. (National Bureau of Standards, Washington, D. C. 20234); Robertson, B. Phys. Rev. D 8: No. 3, 968-970 (1 Aug 1973).

Two tests are proposed for directly establishing violation of CP invariance neutral–kaon decay. Provided that there exist only two neutral kaons, these tests rely only on the principles of quantum theory and relativistic kinematics and, in particular, are independent of the Weisskopf–Wigner approximation made in the theory of Lee, Oehme, and Yang. One of these tests can be made using data that will soon be available and the other can be made with existing techniques. (auth)

3614 CURRENT ALGEBRA AND THE PION MASS IN A GAUGE MODEL. Bars, I.; Lane, K. (Department of Physics, University of California, Berkelely, California 94720). Phys. Rev. D 8: No. 4, 1252-1256 (15 Aug 1973).

Current–algebraic techniques are used to reproduce and extend the results of a gauge model for the pion mass and the ρ′ vector boson. A formula is obtained, giving m_π^2 as an integral over spectral functions of certain SU(2) × SU(2) currents, and valid to second order in the ρ′ coupling constant and all orders in the strong coupling. The general mechanism for generating the pion mass seems to be extendable to a wide class of models. (auth)

3615 GAUGE MODEL FOR THE PION MASS AND THE ρ′ VECTOR BOSON. Bars, I.; Lane, K. (Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. D 8: No. 4, 1169-1179 (15 Aug 1973).

We propose a gauge model which realizes the pseudo–Goldstone idea for the pion, and we calculate its mass. We find m_π^2 as a function of the ρ and A_1 masses and the mass and coupling constant of a new vector meson, which we tentatively identify as the recently discovered ρ′ vector boson. In our model, chiral symmetry is broken by the absence of the axial–vector partner of the ρ′. (auth)

3616 CABIBBO ANGLE AND ROTATION PROJECTION. Palmer, W.F. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. D 8: No. 4, 1156-1159 (15 Aug 1973).

The hadron Hamiltonian for strong and nonleptonic weak interactions is regarded as a function of the Cabibbo angle, evolving from a primitive "initial condition" (in which weak and strong hypercharge are identical) to its physical value by a rotation projection. Various existing determinations of the Cabibbo angle are reproduced and a new one is calculated, with good numerical results for an initial condition in which chiral SU(2) is broken only by an octet term in the electromagnetic direction. (auth)

3617 DUAL MODELS WITH GLOBAL SU(2,2) SYMMETRY. Mansouri, F. (Department of Physics, Yale University, New Haven, Connecticut 06520). Phys. Rev. D 8: No. 4, 1159-1168 (15 Aug 1973).

The possibility of enlarging the gauge symmetry of the dual resonance models is considered by studying the structure of SU(2,2)– [or SO(4,2)] invariant dual models. n–point functions based on the degenerate representations of SU(2,2) are worked out in detail, and a condition under which these amplitudes are dual is specified. Dual models based on the nondegenerate representations are also discussed. Through a physical interpretation of the characteristics which emerge, a possible connection between the dimension, N–1, of the hadronic matter and the gauge–symmetry group SO(N,2) is pointed out. (auth)

3618 SU_3 INCLUSIVE SUM RULES FOR e^+e^- ANNIHILATION. Campani, E. (Scuola Normale Superiore, Pisa, Italy). Lett. Nuovo Cim.; 8: No. 7, 461-465(13 Oct 1973).

The production of π and K mesons in the annihilation process $e^+ + e^-$ hadrons is examined. By using inclusive sum rules which satisfy SU(3) invariance one can obtain bounds on the K/π production ratio. (JFP)

3619 IMPROVED CALCULATION OF THE STRUCTURE FUNCTIONS OF THE NUCLEON IN THE O(4,2)-INFINITE MULTIPLET MODEL. Baiquni, A.; Barut, A. O. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Lett.; 46B: No. 3, 423-425(1 Oct 1973).

A new investigation of the inelastic electron scattering from proton in the O(4,2) models is presented. The resultant explicit structure functions in the limit satisfy scaling, $F_1(\xi) \neq 0$ ($\sigma_T \neq 0$), the Drell–Yan relation $F_2(\xi) \sim (1-\xi)^3$ and, approximately, the Callan–Gross relation $F_2(\xi) \approx 2\xi F_1(\xi)$. (auth)

3620 DEEP INELASTIC STRUCTURE FUNCTIONS FROM COLLINEAR SU(1,1) SYMMETRY. De Franceschi, G.; Etim, E.; Ferrara, S. (CNEN, Frascati, Italy). Phys. Lett.; 46B: No. 3, 452-454(1 Oct 1973).

A model of deep inelastic processes, based on conformal symmetry arguments, in which the structure functions for the scattering and annihilation channels both scale and are related by the Gribov–Lipatov relation is exhibited. Analytic continuation, however, is not valid in general. (auth)

3621 SEARCH FOR CP-VIOLATION IN $K^0 \to 3\pi^0$ DECAY. Barmin, V. V.; Barylov, V. G.; Davidenko, G. V.; Demidov, V. S.; Dolgolenko, A. G.; Zombkovskaya, N. K.; Matveev, V. A.; Meshkovsky, A. G.; Mirosidi, G. S.; Novikov, L. S.; Chistyakova, T. A.; Chuvilo, I. V.; Shebanov, V. A.; Shishov, N. N. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett.; 46B: No. 3, 465-467(1 Oct 1973).

Using the 180 liter ITEP liquid xenon bubble chamber the time distribution of 22 $K^0 \to 3\pi^0$ decays was studied. For the ratio η_{000} of amplitudes $K_S \to 3\pi^0$ and $K_L \to 3\pi^0$ decays $\mathrm{Re}\,\eta_{000} = -0.04 \pm 0.45$ and $\mathrm{Im}\,\eta_{000} = 0.45 \pm$ [illegible] were found. Assuming CPT invariance $|\eta_{000}|^2 < 1.2$ and $\Gamma(K_S \to 3\pi^0)/\Gamma(K_S) \leq 4.3 \times 10^{-4}$ at 90% confidence level were obtained. (auth)

Applications (Strong)

Refer also to abstracts 3535 and 3553.

3622 QUANTIZATION AND GAUGE FREEDOM IN A THEORY WITH SPONTANEOUSLY BROKEN SYMMETRY. Yao, Y. P. (Univ. of Michigan, Ann Arbor). Phys. Rev., D; 7: No. 6, 1647-1660(15 Mar 1973).

A model with spontaneously broken symmetry in the asymmetrical gauge $\partial_\mu A^\mu = (\kappa^2/m)\Phi$, where A_μ is the vector meson with mass m and Φ is the gauge excitation field, is quantized. It is shown that κ^2 can be identified as the mass parameter of the Φ field, in addition to the numerical parameter ξ defined in the text. This implies that Φ is not a Goldstone boson. A renormalization gauge corresponds to any gauge with κ^2 finite. One can formally go over to the unitarity gauge by the limit $\kappa^2 \to \infty$. However, this limit should be taken with extreme care, so as not to interfere with the limits of internal-loop integration. Several examples, including the anomalous magnetic moment of an electron, are given to illustrate that physical quantities are gauge-invariant, the gauge with $\xi = 1$ and $\kappa^2 = m^2$ is particularly convenient for finite calculations, ambiguities may arise if the $\kappa^2 = \infty$ is taken haphazardly, and renormalization constants are gauge-dependent and in some cases can be defined only for certain values of κ^2. (auth)

Scattering Theory

Refer also to abstract 4049.

3623 (CRN/HE-73-6) POLES OF THE S MATRIX FOR A RECTANGULAR COMPLEX POTENTIAL WELL. Joffily, S. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires). 1973. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

The poles of the S-function in the momentum k-plane for S-wave scattering in a complex well potential are calculated. The change caused by the complex character of the potential in the singularity structure of the S-matrix is described in detail. The analytical properties, symmetry relations, unitarity, and causality requirements are discussed. (auth)

3624 (JINR-P4-7109) INVERSE PROBLEM IN RELATIVISTIC THEORY OF QUASIPOTENTIAL SCATTERING. Amirkhanov, I. V.; Grechko, V. E.; Dement'ev, R. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

In the framework of the quasipotential approach the method of introduction of a continuous parameter is applied to the solution of inverse problem of relativistic particle scattering. (auth)

3625 (JINR-P4-7349) APPROXIMATE METHODS IN INVERSE SCATTERING PROBLEMS (ALGEBRAIC APPROACH). Zhigunov, V. P.; Zakhar'ev, B. N.; Niyazgulov, S. A.; Suz'ko, A. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 13p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

In the approximation, when the wave function is constructed with the basic elements Φ_n of N-dimensional function space ($\Psi \approx \Psi^N = \Sigma_n^N F_n \Phi_n$), it is shown that the inverse problem solution produces the potential as a linear combination of the same functions Φ_n: $V \approx V^N = \Sigma_n^N C_n \Phi_n$. The case of particle scattering by nonspherically symmetric potential is considered. (auth)

3626 (JINR-P4-7386) REAL WEINBERG FUNCTION AT POSITIVE ENERGY. Efimov, V. N.; Shul'ts, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 22p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

Starting with the fact that in the case of exactly soluble square well potential at positive energies there are real Weinberg functions belonging to both the positive and negative eigenvalues, it is shown that there is a similar situation with the Yukawa potential. The results obtained indicate that any expansion for positive energies in terms of Weinberg functions converges if and only if the eigenfunctions belonging to negative eigenvalues are taken into account. (auth)

3627 POLES OF THE S-MATRIX FOR A COMPLEX POTENTIAL. Joffily, S. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Phys.; A215: No. 2, 301-313(1973).

The poles of the S-function in the momentum k-plane for S-wave scattering in a complex well potential are calculated. The change caused by the complex character of the potential in the singularity structure of the S-matrix is described in detail. The analytical properties, symmetry relations, unitarity and causality requirements are discussed. (auth)

3628 ADDITIVITY OF PHASE SHIFTS. Kohmura, T. (Tokyo Univ. of Education). Lett. Nuovo Cim.; 8: No. 6, 357-360(6 Oct 1973).

It is shown that the additivity of phase shifts holds if and only if second order in $\mu V(r)/k^2$ is negligible for nonrelativistic scattering from a spherically symmetric potential V(r), which may be composed of potentials $V_j(r)$ for individual sources. For this purpose a differential equation for phase shifts is introduced. (JFP)

3629 INVERSE SCATTERING PROBLEM OF QUANTUM THEORY. Jean, C.; Sabatier, P. C. (Universite des Sciences et Techniques du Languedoc, Montpellier, France). Nuovo Cim.; 18A: No. 1, 105-150(1 Nov 1973).

The properties of the symmetric kernel f(r,r′) appearing in the analysis of the inverse problem at fixed energy were previously obtained by one of the authors, who used a special method. They are derived here in a slightly more general form from the results obtained by Regge and Loeffel, who applied the Gel′fand-Levitan method. Hence there is now a link between the Gel′fand-Levitan procedure, which is of general use in inverse problems, and the fundamental properties which made possible the complete solution of the inverse problem at fixed energy, although those properties were previously obtained by a completely different analysis. Besides, the present approach enables one to get rid of properties of differentiability of the potential, which were used in the former analysis, and are not justified by physical constraints. (auth)

3630 LOW-ENERGY BEHAVIOR OF THE FEW-BODY SCATTERING AMPLITUDES. Adhikari, S.K. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). Phys. Rev. D 8: No. 4, 1195-1204 (15 Aug 1973).

We know that the two-body scattering amplitude at low energy goes to a constant. Only recently, it has been shown by Amado and Rubin that the three-body scattering amplitude at low energy diverges like $aE^{-1} + bE^{-1/2} + c\ln E$, where E is the three-body center-of-mass energy. We here calculate the coefficients a,b,c in terms of the two-body s-wave scattering length and some kinematical factors. We extend our analysis for the four-body case and find that at low energy the four-body scattering amplitude also diverges, and we classify the divergent terms and indicate how to calculate their coefficients. Beyond the four-body problem the scattering amplitude also diverges at low energy, and we indicate what is needed to calculate the coefficients of the divergent terms in general. (auth)

3631 TRANSITION OPERATOR FOR MATRIX POTENTIALS: AN APPLICATION TO THE PION-NUCLEON INTERACTION. Desgrolard, P.; Hammann, T.F. (Institut d'Etudes Nucléaires, Alger, Algérie). Phys. Rev. C 8: No. 3, 888-895 (Sept 1973).

The transition operator corresponding to a separable, nonlocal, matrix-type potential is studied theoretically. It is shown that the transition operator possesses the same $\vec{r}$ (or $\vec{k}$) dependence and properties of separability and nonlocality as the potential and that it is also of a matrix type. This transition operator is then explicitly calculated. A numerical application is made to the simple but physically important case of the low-energy pion-nucleon interaction. The behavior of the transition operator coefficients versus the incident energy is discussed in detail for S, P, and D waves. (auth)

3632 BOUNDARY-CONDITION APPROACH TO THREE-PARTICLE FINAL STATES. Brayshaw, D.D. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 8: No. 3, 952-960 (1 Aug 1973).

It is shown that the wave function for a three-particle system outside the range of forces may be uniquely determined by imposing a suitable set of boundary conditions. This result is expressed in terms of a one-variable integral equation with a square-integrable kernel, the solutions of which specify the three-body t matrix. The input to this equation consists of the two-particle phase shifts and two independent real-valued functions which characterize the three-body wave function in specific regions. The formalism yields an exactly unitary three-particle t matrix for arbitrary values of this input, and thus provides a practical scheme for the analysis of three-body final states. (auth)

3633 ON NONRELATIVISTIC FIELD THEORY: INTERPOLATING FIELDS AND LONG-RANGE FORCES. Klein, J.R. (Department of Physics, Iona College, New Rochelle, New York 10801); Zinnes, I.I. J. Math. Phys. (N.Y.) 14: No. 9, 1205-1212 (Sept 1973).

A field-theoretic version of nonrelativistic, multichannel scattering theory is presented in which the particles interact via two-body potentials, which can include both long-range (Coulomb, etc.) and short-range potentials. By utilizing known first-quantized results, in and out fields and interpolating fields are constructed both for simple and composite particles, and an asymptotic condition using strong convergence is proved. Complexities present when long-range potentials are involved are discussed. (auth)

3634 INTEGRAL EQUATIONS FOR FOUR NUCLEONS WITH ACCOUNT OF SPIN AND ISOSPIN. Narodetskii, I. M.; Grach, I. L. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 3, 667-683(Sep 1973). (In Russian).

The integral equations of the Yakubovsky type are obtained for four nucleons with account of the Pauli principle. The case is considered where the nucleons interact only in the even orbital momentum states. The interaction potential is assumed to be

central. The equations are written for the states with quantum numbers S,T = 0, 1, 2. If the two-particle scattering amplitude is represented by a sum of separable terms, the obtained equations are reduced to systems of two-dimensional integral equations. (auth)

3635 QUASI-POLE MODEL FOR THE HIGH ENERGY SCATTERING AMPLITUDE. Tsarev, V. A. (Lebedev Inst. of Physics, Moscow). Nucl. Phys.; B63: 301-312(1973).

A quasi-pole model for the scattering amplitude is constructed by the summation of cross-channel resonance contributions. In this model Regge poles at $t > 0$ are on the first sheet of the complex angular-momentum plane, but at $t \le t' \le 0$ pass to the second sheet through the fixed cut which arises due to resonance width. In some s- and t-regions these poles are close to the real axis and determine properties of the amplitude, imitating the presence of moving poles on the first sheet. The model explains recent data on elastic high-energy pp scattering. (auth)

3636 HIGH-ENERGY ELASTIC AMPLITUDES ASSOCIATED WITH RISING TOTAL CROSS SECTIONS. Kiang, D.; Morita, K. (Dalhousie Univ., Halifax, N.S.). Progr. Theor. Phys. (Kyoto); 49: No. 5, 1616-1629(May 1973).

A class of high energy elastic amplitudes associated with nondecreasing total cross section is constructed with three basic assumptions. It is shown that several models proposed thus far are all special cases of this class. Quantitative constraints are obtained concerning the rate of shrinking of the diffraction peak and the rate of rising of the total cross sections. The analyticity of the amplitude in the complex l-plane is also studied. (auth)

3637 TRACE-CLASS OPERATORS OF SCATTERING THEORY AND THE ASYMPTOTIC BEHAVIOR OF SCATTERING CROSS SECTION AT HIGH ENERGY. Martin, P. (Univ. of Denver); Misra, B. J. Math. Phys. (N. Y.); 14: No. 8, 997-1005 (Aug 1973).

Necessary and sufficient conditions under which the difference of the resolvents $R_z - R_z^0$ of two self-adjoint operators of the form $H_0 = F(P)$ and $H = F(P) + V(Q)$ is nuclear. Here F(P) denotes a positive and continuous function of the usual momentum observables P and V(Q) a function of the conjugate coordinate observables. Roughly speaking, it is proven that $R_z - R_z^0$ is nuclear if and only if F(P) increases faster than $|P|^3$ at large $|P|$ and V(Q) falls off to zero faster than $1/|Q|^3$ at large $|Q|$. In particular, it is noticed that if $H_0 = (|P|^2 + m^2)^{1/2}$ the relativistic free Hamiltonian, then $R_z - R_z^0$ is not nuclear for any of the (suitably regular) potential $V(Q_{N.W})$ where $Q_{N.W}$ denotes the usual Newton–Wigner position operator of the relativistic particle. Also the necessary and sufficient conditions for $R_z^\beta\ V\ R_z^{0\beta}$ ($\beta > 0$; $\beta \neq 1$) to be nuclear are investigated. The implications of these results for the asymptotic behavior of the total scattering cross sections at high energy is discussed. (auth)

3638 DISCRETE INVERSE SCATTERING PROBLEMS. II. Case, K. M. (Rockefeller Univ., New York). J. Math. Phys. (N. Y.); 14: No. 7, 916-920(Jul 1973).

A discrete version of the inverse scattering problem of the Schrödinger equation with a potential is discussed. The approach is via the Marchenko equation. Interest is primarily pedagogical. All steps are elementary and relatively obvious. Passage to the continuous case as a limit is heuristically straightforward. An example shows "how" the formalism does produce the potential from scattering data. (auth)

3639 MULTICHANNEL STATIONARY SCATTERING THEORY IN TWO-HILBERT SPACE FORMULATION. Prugovecki, E. (Univ. of Toronto). J. Math. Phys. (N. Y.); 14: No. 7, 957-962 (Jul 1973).

Two-Hilbert space versions of the basic integral-representation formulas for wave and transition operators are derived within the framework of time-independent scattering theory. Multichannel scattering theory for state vectors as well as for statistical operators is presented in a two-Hilbert space formulation to which these formulas become applicable. This formulation stays valid when long-range interactions, for which renormalized wave operators exist, are present. (auth)

3640 APPROXIMATE SOLUTION OF THE SCHROEDINGER EQUATION BY MINIMIZING THE DEVIATION. Chang, C. M.; Rapp, D. (Univ. of Texas, Dallas). J. Chem. Phys.; 59: No. 2, 972(15 Jul 1973).

Some scattering problems in atomic collisions are treated by an impact parameter method in which the classical external motion of incident and target particles creates at time dependent perturbation for internal transitions. (JFP)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

3641 (INP-822) MOMENTS OF THE DENSITY–DENSITY CORRELATION FUNCTION OF LIQUID ^{4}He. Parlinski, K. (Institute of Nuclear Physics, Krakow (Poland)). Jan 1973. 37p. Dep. NTIS (U. S. Sales Only) $4.00.

The zeroth, first, second, and third moments of the time-dependent density–density correlation function for liquid ^{4}He at the ground state were calculated. The dual form of the first moment produces a condition which is equivalent to the BBGKY equation. Using the superposition approximation, the equation was solved and the two-particle distribution function was found. On its basis the ground state energy was estimated to be −6.70 K (experiment −7.14 K). To calculate the second moment, the superposition approximation was employed. (auth)

3642 EXPERIMENTAL EVIDENCE OF MACROSCOPIC SPATIAL QUANTIZATION OF ANGULAR MOMENTUM IN ROTATING HELIUM. Deroyon, M. J.; Deroyon, J. P.; Le Ray, M. (Univ., Valenciennes, France). Phys. Lett.; 45A: No. 3, 237-238 (24 Sep 1973).

Simple second sound attenuation ratios in rotating helium show that in the presence of current and even in pure rotation when B_z is nonzero the vortices exhibit a macroscopic spatial quantization described by two quantum numbers l and m. (auth)

3643 EFFECT OF ANOMALIES OF THE ENERGY SPECTRUM OF RELAXATION PHENOMENA IN HELIUM II. Matveev, Yu. A. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 3, 1175-1185(Sep 1973). (In Russian).

The first viscosity coefficient and also the dispersion and absorption coefficients for first and second sounds in helium II at temperatures $<1.7°K$, when the phonon–roton quasiparticle gas can be regarded as perfect, are calculated. The phonon part of the momentum dependence of energy of elementary excitations is assumed to be in the form $\epsilon = cp(1 + \gamma p^2 - \delta p^4)$, where ϵ is the energy, p the phonon momentum, $\gamma = 2.6 \cdot 10^{37}$, $\delta = 2.5 \cdot 10^{75}$ CGSE. The existence in the roton part of the curve of a roton sound momentum $P_c = P_o + \mu c$, where $P_o = 1.9$ cm^{-1}, $\mu = 0.16\ m_{He^4}$ is the roton mass. The kinetic equation for quasiparticles is obtained by a method first developed by Landau and Khalatnikov and developed further by Khalatnikov and Chernikova. A comparison of the theory with the experiments is carried out. (auth)

3644 N. N. BOGOLUBOV'S INEQUALITIES IN SYSTEMS OF MANY INTERACTING PARTICLES WITH BROKEN SYMMETRY. Sadovnikov, B. I.; Fedyanin, V. K. (Moscow State Univ.). Teor. Mat. Fiz.; 16: No. 3, 368-393(Sep 1973). (In Russian).

Some problems of many-particle systems are discussed on the basis of the concept of quasi averages and N. N. Bogolyubov's inequalities for the commutator Green functions. Spontaneous breaking of symmetry in systems under consideration is physically revealing itself in quite different ways: the Ising model, the Heisenberg model with the ferro-, antiferro- and ferri-magnetic ordering, systems of the superfluid and superconductive type, systems with crystallic ordering. (auth)

3645 QUASI-ISOTHERMAL SUPERFLUID FILM OSCILLATIONS. Hallock, R. B.; Flint, E. B. (Univ. of Massachusetts, Amherst). Phys. Lett.; 45A: No. 3, 245-246(24 Sep 1973).

A study was made of the damping and frequency of superfluid film oscillations between two reservoirs. No evidence was found of the frequency shift and decay constant peaking reported by others. (auth)

Superconductivity

Refer also to abstracts 2496, 3006, 3064, 3080, 3085, 3086, 3190, and 3644.

3646 (COO-1569-104) CRITICAL PHENOMENA IN SUPERCONDUCTORS. Solinsky, J. C. (Minnesota Univ., Minneapolis (USA)). Dec 1973. 219p. Dep. NTIS $13.00.

Thesis.

Departures from the predictions of mean field theory (MFT) are not usually observed because the region in temperature ΔT_c (i. e., the critical region) over which the theory is invalid is very small ($\sim 10^{-12}$K) for pure superconductors. The narrowness of this region results from the dependence of ΔT_c on the inverse of the sixth power of the zero temperature value of the temperature dependent coherence length $\xi(T)$, a parameter which measures the size of coherent superconducting regions, and is about 10^4 Å for pure superconductors. This relationship between ΔT_c and $\xi(0)$ is why in superfluid ^{4}He critical phenomena are observed ($\xi(0) \sim 2$ Å) and why MFT works so well for pure superconductors. But ΔT_c can be increased to the order of 10^{-3} K by studying dirty superconductors (i.e., the mean free path $l \ll \xi(0)$) in restricted geometry (i.e., a characteristic length $L \ll \xi(0)$). Experimental studies were carried out with 1000 Å thick dirty granular aluminum films (mass $\sim 20\ \mu g$) which were evaporated onto mica substrates. The electrical conductivity and heat capacity were studied in the superconducting transition region. The resistive transition of the film was used as a thermometer in conjunction with optical heating in an ac calorimetry scheme to measure the films 5×10^{-9} J/K heat capacity. Results presented on four films indicate a rise in the heat capacity near the low temperature region of the transition where the film's resistance becomes zero. This rise peaked in two films studied to a value of up to 32 times the BCS jump in heat capacity and at a temperature of about 20 mK below the MFT transition temperature T_c^{MFT} as determined from the conductivity measurements. An applied magnetic field widened and reduced the peak in the heat capacity while shifting it to a lower temperature. These results indicate that higher order corrections are needed to recent heat capacity predictions for thin films in the transition region. (auth)

3647 (ORNL-TM-4391) DYNAMIC STABILIZATION OF Nb_3Sn TAPE SUPERCONDUCTORS. Koyama, K.; Lubell, M. S. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 18p. Dep. NTIS $3.00.

The stabilization of Nb_3Sn ribbon superconductor achieved by the interleaving of high conductivity aluminum has been experimentally investigated by observing the flux jumping on a rectangular stack placed in a changing transverse magnetic field. The results show that raising the conductivity of the aluminum leads to significantly increased stability as does increasing the thickness at fixed conductivity. The first flux jump field for both cases is given for various rates of increase of the applied transverse field. The limiting value at fast rates is compared to a new theory of dynamic stabilization recently proposed by one of the authors (KK) and found to agree well for the case where the interleaved aluminum is thermally insulated from the superconductor. Agreement is not good when the aluminum is partially contributing to the thermal diffusion in an undetermined amount. (auth)

3648 SUPERCONDUCTING SINGLE–JUNCTION INTERFEROMETERS WITH SMALL CRITICAL CURRENTS. Hansma, P.K. (Department of Physics, University of California, Santa Barbara, California 93106). J. Appl. Phys. 44: No. 9, 4191-4194 (Sept 1973).

A simple theory of the superconducting single-junction interferometer (ac Squid) becomes possible if the critical current of the single junction is small relative to Φ_0/L_s, where $\Phi_0 = h/2e$ is one flux quantum and L_s is the inductance of the interferometer loop. This theory predicts a magnetic flux sensitivity which has the same dependence on interferometer parameters as the existing theories for higher critical currents. In contrast to those theories, however, the present theory predicts that the maximum flux sensitivity will be achieved off resonance. Theoretical predictions for comparison with experiment are displayed as a function of the normalized difference between the operating frequency ω and the resonant frequency ω_0. (auth)

3649 NONLINEAR ACOUSTIC EFFECTS IN SUPERCONDUCTOR. Gal'perin, Yu. M.; Gurevich, V. L.; Kozub, V. I. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 65: No. 3, 1045-1060(Sep 1973). (In Russian).

Nonlinear effects occurring on the propagation of supersonic waves in a superconductor are considered. A kinetic equation for quasi-particle excitations in the field of a strong sound wave is derived by a technique similar to the Keldysh technique. It is shown that for long-wave sound (the wavelength of which is much greater than the electron mean free path) the nonlinearity parameter is the ratio of the characteristic electron-wave interaction energy to the Fermi energy. In the case of shortwave sound momentum nonlinearity occurs which is similar to that known for a normal metal and which is due to capture of part of the excitations by the sound wave field. Allowance for this mechanism may be important, in particular, in studies of the gap anisotropy by acoustic methods. A specific nonlinear effect is considered which is manifest in the appearance of a phase gradient of the order parameter near the sample in which intense sound is propagating. The possibility of observing the effect is appraised. (auth)

3650 EFFECT OF HIGH HYDROSTATIC PRESSURE AND RESIDUAL STRAIN ON THE SUPERCONDUCTIVITY OF Nb–Al–Ge ALLOYS WITH AN A15 TYPE STRUCTURE. Galev, V. N.; Rabin'kin, A. G. (Inst. of Chemical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 3, 1061-1075(Sep 1973). (In Russian).

The dependence of T_c on p (up to 38 kbars) is investigated in Nb–Al–Ge alloys annealed at 1650°C and possessing compositions lying in the stability region of the A15 phase. In all alloys, excluding Nb_3Al, T_c varies linearly with the pressure. A phase transition of the first kind with $\Delta V/V_0 \sim 1\%$ is observed in the Nb_3Al alloy in the vicinity of 17 kbars; T_c of the new phase is somewhat higher. It is shown that when Ge replaces Al in $Nb_{3+y}(Al_{1-x}Ge_x)_{1-y}$ alloys, the dependence $dT_c/dp = f$ (at.% Ge) changes sign twice. This pattern is ascribed to the presence of singularities in the dependence of the state density at the Fermi surface on the composition. The alloys are found to be very sensitive to compression under nonhydrostatic conditions (p up to 20 kbars). Such action produces a strong "smearing out" of the transition to the superconducting state and a considerable decrease of the volume of alloys with a high T_c. The alloys which are most sensitive to inhomogeneous stresses are those which lie on the Nb–Al–Ge state diagram near the phase equilibrium point or at the edges of the single-phase region. (auth)

3651 STABILITY OF NONEQUILIBRIUM FERMI DISTRIBUTIONS WITH RESPECT TO COOPER PAIRING. Aronov, A. G.; Gurevich, V. L. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 65: No. 3, 1111-1125(Sep 1973). (In Russian).

The stability of normal and superconducting nonequilibrium Fermi systems relative to Cooper pairing and Cooper pair decay respectively is investigated. If the inequality $\hbar/\tau\Delta \ll 1$ is obeyed, where Δ is the superconducting gap thickness and τ is the electron–phonon collision time, the stability condition does not depend explicitly on the mode of creation of inequilibrium and is expressed only in terms of the superconducting excitation distribution function $m(\epsilon)$. It is shown that if the sign of the difference $1 - 2m(\epsilon)$ is constant throughout the complete energy region ϵ, the superconducting state will be stable. The stability condition obtained is employed for analyzing a number of concrete cases. (auth)

3652 EFFECT OF THE LOW-FREQUENCY PEAKS OF THE PHONON STATE DENSITY ON THE CRITICAL TEMPERATURE OF SUPERCONDUCTORS. Medvedev, M. V.; Pashitskii, E. A.; Pyatiletov, Yu. S. (Inst. of Physics of Metals, Sverdlovsk, USSR). Zh. Eksp. Teor. Fiz.; 65: No. 3, 1186-1197(Sep 1973). (In Russian).

A general expression for the critical superconducting transition temperature T_c is obtained on basis of the Eliashberg equations for superconductors with strong coupling and by employing a simple approximation of the gap in the form of a step-like alternating function. It is shown that in the derivation of the familiar McMillan formula for T_c, some important renormalization terms containing an essential functional dependence of T_c on the shape of the phonon spectrum were either lost in the index of the exponential function, or were incorrectly evaluated. Consequently the formula does not correctly describe the behavior of T_c in the presence of low-frequency peaks in the phonon state density. It is shown within the model of a phonon spectrum consisting of two Einstein peaks that on decrease of frequency ω_1 of one of the peaks T_c passes through a maximum, and then decreases together with the effective coupling constant as $\omega_1 \to 0$. In other words on "softening" of the lattice (e.g., near the phase transition) T_c may not increase but rather decrease. (auth)

3653 INHOMOGENEOUS STATE AND THE ANISOTROPY OF THE UPPER CRITICAL FIELD IN LAYERED SUPERCONDUCTORS WITH JOSEPHSON LAYER INTERACTION. Bulaevskii, L. N. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 3, 1278-1288(Sep 1973). (In Russian).

Anisotropy of the upper critical field H_{c2} in layered superconductors with Josephson interaction of the layers is investigated. It is shown that in pure (along the layer) superconductors at low temperatures an inhomogeneous state is realized for field directions which are close to the layer direction, providing the Cooper pairs in the field H_{c2} are not in the lower Landau orbit. The angular dependence of H_{c2} at $T = 0$ and the temperature dependence of $H_{c2}(\|)$ are obtained for pure superconductors. The dependence of $H_{c2}(\perp)$ on temperature and purity of the crystals is investigated. It is shown that in dirty superconductors the transition from the normal to superconducting state at low temperatures may be a transition of the first kind for field directions close to a parallel direction and a transition of the second kind for other directions. The experimental data for $TaS_2(Py)_{1/2}$ are analyzed and it is shown that Josephson interaction of layers occurs in this compound. (auth)

3654 HARMONIC GENERATION PROCESS OF GOR'KOV AND ÉLIASHBERG. McLean, W. L.; Amato, J. C. (Rutgers-the State Univ., New Brunswick, NJ). Phys. Lett.; 45A: No. 4, 289-290(8 Oct 1973).

The practicability is discussed of observing one of the electromagnetic phenomena in gapless superconductors predicted by Gor'kov and Éliashberg. The use of realistic boundary conditions shows that the effect should be more difficult to observe than they had indicated. (auth)

3655 SPECTRUM OF ^3He ATOMS IN SUPERFLUID ^4He. Varma, C. M. (Bell Telephone Labs., Inc., Murray Hill, NJ). Phys. Lett.; 45A: No. 4, 301-302(8 Oct 1973).

It is suggested that at a wave vector near the inverse average interparticle separation, the spectrum of a ^3He atom in superfluid ^4He has a roton like dip. The results of light scattering and transport measurements in liquid ^3He–^4He mixtures can thereby be reconciled. (auth)

3656 NEGATIVE TEMPERATURE COEFFICIENT OF RESISTANCE AND SUPERCONDUCTIVITY OF NIOBIUM NITRIDE THIN FILMS. Ayer, W. J. Jr.; Rose, K. (Rensselaer Polytechnic Inst., Troy, NY). Phys. Lett.; 45A: No. 4, 333-334(8 Oct 1973).

NbN thin films have been studied which exhibit both a negative TCR in the normal state and superconductivity. The disappearance of superconductivity along these films appears to be caused by the onset of strong localization of the electronic states in the inter-islandic regions. (auth)

3657 POLARIZATION OPERATOR OF A SUPERCONDUCTING ELECTRON GAS: THE KOHN ANOMALIES AND CHARGE SCREENING IN SUPERCONDUCTORS. Gabovich, O. M.; Pashits'kii, E. A. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Ukr. Ed.); 18: 544-552 (Apr 1973). (In Ukrainian).

A superconductor model proposed by Bardeen et al. (1962) is used as a basis for calculating the statistical polarization operator of a superconducting electron gas. The mechanism of the Kohn anomaly diffusion in the phonon spectrum of metals is discussed. Conditions under which the asymptotic properties of a potential charge are modified by screening are considered and defined. (IAA)

3658 EFFECT OF A DIELECTRIC COATING ON THE CRITICAL TEMPERATURE OF SUPERCONDUCTING FILMS. Uspenskii, Yu. A.; Zharkov, G. F. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1460-1466(Oct 1973). (In Russian).

The effect of a dielectric coating on the critical temperature T_c of thin superconducting films is studied within the framework of a model previously proposed by the authors. The dependence of T_c on the parameters of the dielectric is discussed. It is found that the increase of T_c in such systems strongly depends on the ratio of the Fermi wavelength to the Debye screening radius in the film. It is shown that although allowance for the dielectric coating does not lead, according to the model, to any significant increase of T_c of the metallic film, there still remain a number of possibilities for further investigation in this direction. (auth)

3659 POSSIBLE MECHANISM FOR THE PEAK EFFECT IN SOLID SUPERCONDUCTORS. Kluge, G.; Rudat, F. (Univ., Jena, Ger.). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1481-1488(Oct 1973). (In Russian).

The interaction between the flux line lattice and a periodic distribution of dislocations is investigated. The mean pinning force has a peak if the periodicity of the flux line lattice is equal to that of the dislocation array. The results agree with the experimental findings. (auth)

3660 SURFACE AND VOLUME VORTEX PINNING IN TYPE II SUPERCONDUCTORS. Fogel, N. Ya. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1534-1540(Oct 1973). (In Russian).

Experimental investigations are carried out on the dependence of the pinning force F_p on magnetic field strength, temperature and Ginzburg–Landau parameter $\varkappa$ in a system of superconducting alloys Pb–In in which pinning is mainly determined by surface pinning of the vortexes. The main laws determining the behavior of F_p are elucidated. It is found that in the alloys investigated the pinning forces obey the law of corresponding states. It is shown that the expression for the pinning force can be represented as the product of three functions, each of which depends only on one of the essential variables, $t = T/T_c$, $h = H/H_{c2}(t)$ or $\varkappa$. The results of the experiments are in good agreement with Schmidt's theory which consider vortex pinning at the plane boundary of a perfect superconductor of the second kind. The temperature dependence of F_p differs from that observed in alloys with volume pinning. It is shown that this difference is due to the fact that the depth of the layer, in which surface pinning is efficient, is the same as the depth of penetration and depends on the temperature. (auth)

3661 DESTRUCTION OF SUPERCONDUCTIVITY IN THIN NARROW FILMS BY A CURRENT. Andratskii, V. P.; Grundel, L. M.; Grubankov, V. N.; Pavlov, N. B. (Inst. of Radio Engineering and Electronics, Moscow). Zh. Eksp. Teor. Fiz., 65: No. 4, 1591-1599(Oct 1973). (In Russian).

The conditions for destruction of superconductivity by a current is studied in thin (440 to 800 Å), narrow (1 to 2 μ) Sn films. It is demonstrated that in the absence of a magnetic field the critical currents measured are consistent with those estimated on basis of the condition of suppression of the edge potential barrier. In accordance with the phenomenological theory, in films with even edges the suppression occurs when the current density at the edges becomes equal to the unpairing current density. At temperatures for which the current is uniformly distributed over the cross section, the unpairing current in films with even edges can be attained experimentally. In films with strong edge defects the critical currents decrease as a result of penetration of the vortexes through local low regions in the barrier. It is shown that the nature of vortex pinning in films is altered in a magnetic field. (auth)

3662 RATE OF PENETRATION OF A MAGNETIC FLUX INTO SUPERCONDUCTORS OF THE SECOND KIND. Petukhov, B. V.; Chechetkin, V. R. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1653-1657(Oct 1973). (In Russian).

The time required for a vortex to surmount the surface barrier in Type-II superconductors is calculated. The dependence of activation energy for formation of a vortex nucleus on magnetic field strength is determined. The pre-exponential factor in the transition probability is found near H_{c1} from the Fokker–Planck equation. (auth)

3663 THEORY OF THE PROPERTIES OF SUPERCONDUCTORS WITH A β-W STRUCTURE. Gor'kov, L. P. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1658-1676(Oct 1973). (In Russian).

A theory of the properties of superconductors with a β-W structure is proposed which is based on the assumption that in linear chains the Fermi level passes through point X of the inverse lattice at which the electron bands are two-fold degenerate and possess a linear dispersion law. It is shown that in this case the electron corrections to the energy involve a structural transition which proceeds the transition to the superconducting state. The transition, however, should occur at close temperatures. This is a solution of the problem of the relation between instability and superconductivity in these compounds, which are two aspects of a single phenomenon, viz. instability of the electron spectrum. The theory predicts logarithmic temperature dependences of all quantities above the transition point. In the high temperature region the dependences are linear for elastic moduli. This is consistent with the experiments. (auth)

3664 ELECTRODYNAMICS OF INHOMOGENEOUS SUPERCONDUCTORS OF THE SECOND KIND. Larkin, A. I.; Ovchinnikov, Yu. N. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1704-1714(Oct 1973). (In Russian).

A broad range of electric and magnetic fields, in which the current is a universal function of the ratio of electric field strength to critical current, exists in type-II superconductors possessing weak inhomogeneities of the effective interaction between electrons, of the mean free path and of the film thickness. The dependence of the critical current on magnetic field strength and temperature is found in this region. (auth)

3665 ASYMPTOTIC BEHAVIOR OF THE MAGNETIC FIELD AND ATTRACTIVE INTERACTION BETWEEN FLUX LINES IN TYPE-II SUPERCONDUCTORS. Mancini, F. (Univ., Salerno, Italy). Phys. Lett.; 45A: No. 3, 179-180(24 Sep 1973).

It is shown that type-II superconductors with a Ginzburg–Landau parameter κ less than a critical value κ_c exhibit a first order transition at H_{c1}. (auth)

3666 EFFECT OF FLUCTUATIONS ON DIAMAGNETIC SUSCEPTIBILITY OF ZERO-DIMENSIONAL SUPERCONDUCTORS BELOW T_c. Kumar, P.; Shukla, G. C. (Univ. of Roorkee, India). Phys. Lett.; 45A: No. 3, 229-230(24 Sep 1973).

The effect of fluctuations of superconducting order parameter on the diamagnetic susceptibility χ of a zero dimensional superconductor is studied below T_c, using the phenomenological Ginzburg–Landau theory. χ is found to increase exponentially with the decrease of temperature below T_c and has a finite value at the critical temperature. (auth)

Equipment and Devices

Refer also to abstracts 4672, 4679, and 4680.

3667 (CEA-R-4419) STUDIES, DEVELOPMENT, AND TESTING OF A DEVICE FOR DYNAMICALLY MEASURING SPECIFIC HEATS BETWEEN 4 AND 300°K. Lagnier, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Jul 1973. 72p. (In French). Dep. NTIS (U. S. Sales Only) $5.75.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

An apparatus for measuring the specific heat of various materials between 4 and 300°K is described. These measurements are carried out with linear rise in temperature thereby ensuring very rapid operations and measurements. The first part of the study is devoted to a detailed description of the apparatus, and of the method of differential calorimetry by power compensation used for this type of measurement. A critical study of the apparatus in operation, on the basis of a series of tests, is given. Also, a statement of the results of measurements of specific heat on miscellaneous samples is given, thereby establishing the range of possibilities offered by the use of the apparatus (copper, alumina, niobium, niobium-titanium, and erbium orthochromite). (auth)

3668 (ORNL-TM-4341) CRYOGENIC DIELECTRICS AND SUPERCONDUCTING AND CRYOGENIC MATERIALS TECHNOLOGY FOR POWER TRANSMISSION. Annual Report, July 1, 1973. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 150p. Dep. NTIS $9.50.

The principal effort in the dielectric program during this reporting period, March 1 to June 20, has been to install the 700 kV series resonant transformer so that high voltage ac testing can be accomplished during the coming year. Provisions were made that this unit will share a test stand with the Haefely 600 kV dc power supply. Design and fabrication of a helium dewar with a 1000 kV bushing for use in this test stand has continued. The design of a cryostat for experiments with intermediate voltages was completed, and the assembling of this cryostat is under way. A small laboratory for exploratory experiments with voltages up to 130 kV dc and 80 kV ac has been set up. A Biddle partial discharge detector has been ordered. A Faraday cage has been located which can provide a low interference laboratory for low level discharge measurements. Auxiliary investigations have been continued which are necessary for the design, construction, and operation of our test equipment. The superconducting materials study has continued with work in three main areas: 1) niobium-rare earth dispersion studies, 2) measurement of critical current density, J_c, and surface shielding parameter, ΔH, in the dispersions, and 3) construction of ac loss measuring equipment. The dispersion hardening of aluminum activity has concentrated on a study of the residual resistivity ratio of the high purity zone-refined aluminum from Cominco Products since the material barely reached 80% of the specified value of 13,000 ± 1000. Sensitivity of the residual resistivity of the material to handling and thermal history was explored and compared with previous materials obtained from Cominco which met the same specification. The results which indicate a high sensitivity and a possibility of a maximum in the residual resistivity ratio as a function of annealing temperature do not clearly show why the two lots of material should differ. A set of alloy ingots was prepared to make specimens to study hardening characteristics vs electrical resistivity. (auth)

3669 INFLUENCE OF SOLUTE OXYGEN AND NITROGEN ON SUPERCONDUCTING NIOBIUM CAVITIES. Giordano, S.; Hahn, H.; Halama, H.J.; Varmazis, C. (Brookhaven National Laboratory, Upton, New York 11973); Rinderer, L. J. Appl. Phys. 44: No. 9, 4185-4190 (Sept 1973).

The influence of solute oxygen and nitrogen on the magnetic breakdown and residual losses of superconducting niobium cavities was investigated experimentally by exposing the cavities to these gases at pressures up to 10^{-5} Torr during the heat treatment at 2100 K. We have collected evidence that the oxygen exposure increases the residual losses and, at bulk concentrations of about 0.1 at.%, the breakdown field is substantially lowered. Penetration depth measurements seem to indicate high values of the Ginzburg-Landau parameter $\kappa \simeq 4.4$ in the surface sheath which could explain the low rf breakdown observed. (auth)

3670 NOISE IN THE SUPERCONDUCTING QUANTUM FLUX DETECTOR. Kurkijaervi, J. (Cornell Univ., Ithaca, NY). J. Appl. Phys.; 44: No. 8, 3729-3733(Aug 1973).

An expression is derived for noise in the tank circuit of a superconducting quantum flux detector run at a radiofrequency. This noise is limited by the sensing element of the device, the superconducting ring with a weak link, and is therefore intimately related to the thermal fluctuations in the ring. Not considering external noise, the superconducting ring and the tank circuit together with the preamplifier should exhaust the important sources of noise in the flux detector. (auth)

3671 TE_{011} X-BAND NIOBIUM CAVITY WITH CRITICAL MAGNETIC FLUX DENSITY HIGHER THAN B_{c1}. Schnitzke, K.; Martens, H.; Hillenbrand, B.; Diepers, H. (Siemens AG, Erlangen, Ger.). Phys. Lett.; 45A: No. 3, 241-242(24 Sep 1973).

Microwave critical magnetic flux densities B_c^{ac} of nearly 160 mT were obtained with a TE_{011} X-band niobium cavity, these values being higher than the lower critical field B_{c1} of the cavity material. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 3777, 4507, and 4541.

3672 (BNL-18252) DEVELOPMENT AND STATUS OF THE EVALUATED NUCLEAR DATA FILE ENDF/B. Pearlstein, S. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 16p. (CONF-731015-3). Dep. NTIS $3.00.

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973).

The Evaluated Nuclear Data File is part of a system developed by the USAEC to improve the quality and facilitate the use of nuclear data in applications. The widespread use of a single, well-defined format reduces the number of schemes necessary to process information or compare alternate data sets. A network of checking codes that examine the consistency of the data sets and perform physical checks against known nuclear properties helps to ensure the reliability of the file. The basic elements of the ENDF system are described, and the organization and purposes of the Cross Section Evaluation Working Group (CSEWG) are discussed. (7 figures) (RWR)

3673 (BNL-50387, pp 103-121) USE OF PRE-PROCESSED DATA IN THE RESONANCE RANGE. Ozer, O. (Brookhaven National Lab., Upton, NY). Apr 1973.

From meeting of the Resonance Region Subcommittee of CSEWG; Upton, New York, USA (8 May 1972).

In multi-level effects in reactor calculations and the probability table method.

It is noted that a great amount of computing time and effort can be saved by pre-processing and storing the ENDF data at an intermediate or simplified level. Two levels of pre-processed files are discussed: The first level consists of an ENDF/B-like file of point cross sections. The second level is a multipurpose, multigroup library of group constants and transfer matrices to be used in reactor calculations. A Level I library has been generated at NNCSC; the library, codes used in its preparation, and its applications are discussed in some detail. Plans for formats and contents of a Level 2 library are briefly presented. (LBS)

3674 (CONF-731101-12) SELECTION OF GROUP ENERGY BOUNDARIES USING SENSITIVITY THEORY. Oblow, E.; Ching, J.; Drischler, J. (Oak Ridge National Lab., Tenn. (USA)). 1973. 3p. Dep. NTIS $3.00.

An attempt was made to use the sensitivity approach to develop an automated scheme for selecting multigroup energy boundaries so as to minimize the energy groups required to solve a specific problem. As a demonstration of the usefulness of the method, a series of problems involving transport in iron were studied. The general conclusion drawn from the results is that a few group problem dependent cross section sets are apparently practical; and if accurate sets with as few as ten groups are possible in other problem areas, it should be quite practical to choose a few hundred group boundaries for a multigroup library which will have guaranteed accuracy in calculating a fair number of widely different problems. (LBS)

3675 (COO-3001-49) DEATH TO PION CONDENSATES IN NUCLEAR MATTER. Barshay, S.; Brown, G. E. (State Univ. of New York, Stony Brook (USA)). 19 Sep 1973. Contract AT(11-1)-3001. 11p. Dep. NTIS $3.00.

It is first noted that if the coupling of spin, isospin modes in nuclei to pions were of anywhere near the strength required to produce pion condensation in nuclear matter, then there would be strong effects in nuclear spectra, which are not seen. A model proposed by A. B. Migdal is worked through and it is shown that addition of a strong short-range repulsion in the nucleon-nuclear interaction modifies the effective interaction in such a way as to remove the main spin-isospin interaction which originally gave rise to the pion condensate. It is believed that short-range repulsions also strongly modify the work of Sawyer and Scalapino, but have not yet shown that they destroy the condensate in neutron stars. The conclusion is that the off-shell p-wave attraction of pions and nucleons lies, at least in the region of low momenta, completely in the domain of the Δ-isobars. Effects from these would be incapable of producing pion condensates, except at extremely high densities, equal to several times normal nuclear density. (auth)

3676 (GULF-GA-A-12052) FSDP3: A COMPUTER PROGRAM FOR COMPUTING CROSS SECTIONS FROM RESONANCE PARAMETERS. Mathews, D. R. (Gulf General Atomic Co., San Diego, Calif. (USA)). 5 Apr 1972. Contract AT(04-3)-840. 96p. Dep. NTIS $7.00.

The FSDP3 computer program is the latest of a series of Gulf General Atomic programs for the computation of pointwise cross sections from resolved resonance parameters. New features include the use of corrected resonance cross section formulas, extension to higher angular momentum values, inclusion of a temperature-dependent multilevel Breit–Wigner scattering option, and a resolved resonance parameter input data option in ENDF/B Version II or III format. (8 figures, 2 tables) (auth)

3677 (ORNL-TM-2880(Rev.)) UKE-III: A COMPUTER PROGRAM FOR TRANSLATING NEUTRON CROSS SECTION DATA FROM THE UKAEA NUCLEAR DATA LIBRARY TO THE EVALUATED NUCLEAR DATA FILE FORMAT. Wright, R. Q.; Cramer, S. N.; Irving, D. C. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 27p. (ENDF-134-R). Dep. NTIS $3.50.

A computer program, UKE, has been written to translate neutron cross sections on computer tape from the United Kingdom Atomic Energy Authority Nuclear Data Library to the Evaluated Nuclear Data File, ENDF/B. The code will translate UK library smooth cross section data, secondary angular distributions, and secondary energy distributions to the ENDF/B format. No resonance parameters, thermal scattering data, or photon data are considered, however. The secondary angular distributions are translated as differential scattering probabilities only, and no Legendre expansion coefficients are given. General information is presented concerning the format of the two libraries along with a detailed description of the translation from the UK secondary energy distribution laws to those of ENDF/B. Programming details and a user's guide are also presented. (auth)

3678 (PRNC-165) ANNUAL REPORT, 1972. (Puerto Rico Nuclear Center, San Juan). 1972. Contract AT(40-1)-1833. 137p. Dep. NTIS $5.45.

Research on neutron diffraction, radiation and hot atom chemistry, nuclear engineering, radiation chemistry, clinical radioisotope applications, radiotherapy and cancer, induced fertility in insects, medical sciences and radiobiology, medical physics, reactors, health and safety and radioecology is summarized. A list of publications is included. (JFP)

3679 (TID-26460-P1) CINDA 73. Volume 1. Z ≤ 52. An Index to the Literature on Microscopic Neutron Data. (USAEC Technical Information Center, Oak Ridge, Tenn.; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.; ENEA Neutron Data Compilation Centre, Gif-sur-Yvette (France); International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). Jun 1973. 866p. IAEA $31.00 (2 Vols. and Suppl.).

3680 (TID-26460-P2) CINDA 73. Volume 2. Z ≥ 53. An Index to the Literature on Microscopic Neutron Data. (USAEC Technical Information Center, Oak Ridge, Tenn.; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.; ENEA Neutron Data Compilation Centre, Gif-sur-Yvette (France); International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). Jun 1973. 943p. IAEA $31.00 (2 Vols. and Suppl.).

3681 NEITRONNAYA FIZIKA. Chast' I. Materialy Vsesoyuznogo Soveshchaniya, Kiev, USSR, 24–28 Maya 1971 g. (Neutron Physics. Part I. Conference Held at Kiev, USSR, May 24–28, 1971). Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). 360p. (CONF-710565-P1).

The proceedings of this conference were published in two volumes divided into the following sections: requirements on nuclear data, general problems of the interactions of neutrons with nuclei, experimental study of the properties of atomic nuclei, physics of nuclear fission, collection and evaluation of nuclear data, methods of neutron spectrometry, and some current problems in neutron physics. A separate abstract was prepared for each of the papers in this volume. (RWR)

For abstracts of individual papers see: 2768, 3141, 3259, 3393, 3739–3741, 3771, 3794–3798, 3822–3825, 3875–3882, 3936–3938, 3972, 3973, 4006–4022, 4100–4111, 4305, 4487, 4500, 4506, 4507, and 4543.

3682 NEITRONNAYA FIZIKA. Chast' II. Materialy Vsesoyuznogo Soveshchaniya, Kiev, USSR, 24–28 Maya 1971 g. (Neutron Physics. Part II. Conference Held at Kiev, USSR, May 24–28, 1971). Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). 324p. (CONF-710565–P2).

This volume of the conference proceedings contains papers on the following subjects: physics of nuclear fission, collection and evaluation of nuclear data, methods of neutron spectrometry, and some current problems in nuclear physics. A separate abstract was prepared for each of the papers in this volume. (RWR)

For abstracts of individual papers see: 2728, 2766, 2767, 2807, 2822, 3161, 3187, 3683, 3684, 3883, 3884, 3939, 3940, 3974, 4023–4041, 4112–4115, 4380, 4508, 4509, and 4537–4540.

3683 EVALUATION OF NUCLEAR DATA. Abramov, A. I.; Zolotukhin, V. G.; Nikolaev, M. N. (Physical-Power Inst., Moscow). pp 128-139 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565–P2.

Some general problems of nuclear data evaluation are discussed. (auth)

3684 ACTIVITY OF THE NUCLEAR DATA CENTER. Popov, V. I. (Physical-Power Inst., Moscow). pp 163-166 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565–P2.

The main trends of the activities of the SCUAE Nuclear Data Center are reported. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 3679, 3881, 3882, 3920, 3939, and 4380.

3685 (BMFT-FBK-73-26) MICROSCOPIC THEORY OF THE GAMMA BREAK-UP OF NUCLEI APPLIED TO THE ^{4}He NUCLEUS. Stoewe, H. (Cologne Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Sep 1973. 77p. (In German). Dep. NTIS (U. S. Sales Only) $6.00.

A method for the calculation of γ-induced break-up processes of nuclei into two fragments is presented. Starting from a microscopic Hamiltonian the ground state and the scattering state wave functions—which describe channel coupling—are obtained using variational methods. The photon is taken into account in first order perturbation theory. As an example E1 and E2 transitions in the ^{4}He system are treated; especially the difference between (γ,p) and (γ,n) cross sections is discussed. (auth)

3686 (JINR-E2-7228) DETERMINATION OF THE COUPLING CONSTANTS H^{3}dn, H^{3}H^{3}π AND He^{3}He^{3}π FROM THE DATA ON THE DIFFERENTIAL CROSS SECTIONS OF THE nH^3 AND H^{3}dn ELASTIC SCATTERING. Dubnicka, S.; Dumbrais, O. V.; Nichitiu, F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

Determination of the coupling constants ^{3}Hdn, ^{3}H^{3}Hπ and ^{3}He^{3}Heπ from the existing data on the differential cross sections of the n^{3}H and n^{3}He elastic scattering was carried out. The method is based on the extrapolation of $d\sigma/d\Omega$ to the deuteron and pion poles exploiting the conformal mapping techniques. Calculations result in the value of the ^{3}Hdn coupling constant which is ~20% smaller than the dispersion relation predictions. The comparison of the obtained value with predictions based on nuclear models allows one to discriminate between different potentials. The residue at the pion pole turns out to be too weak, and the conclusion is drawn that it is impossible to determine the coupling constants ^{3}H^{3}Hπ and ^{3}He^{3}Heπ on the basis of the existing data. (auth)

3687 (JINR-P1-7342) INVESTIGATION OF THE SYNTHESIS REACTION $d\mu + d \rightarrow {}^3He + n + \mu$ IN GASEOUS DEUTERIUM. Bystritskii, V. M.; Dzhelepov, V. P.; Oganesyan, K. O.; Omel'yanenko, M. N.; Porokhovoi, S. Yu.; Rudenko, A. I.; Dil'chenkov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The experiments performed with a gas target filled with superpurified deuteron (relative amount of admixtures with $Z > 1$ is not larger than 10^{-6}) at 41 atm and by using the muon beam from the 680-MeV synchrocyclotron JINR allowed the measurement of the yields and the time distribution of neutrons from the fusion reaction in the ddμ mesic molecules. The analysis of this distribution (851 events) made it possible to obtain the values of the $\Lambda_{dd\mu}$ formation rate of the ddμ molecule in gaseous deuterium with T = 300°K and the Λ_f nuclear reaction rate in this mesic molecule. The obtained value $\Lambda_{dd\mu} = (0.73 \pm 0.07) \times 10^6\ \mathrm{sec}^{-1}$ together with earlier data for T = 240° (obtained by using a diffusion chamber) confirms the existence of the resonance mechanism of the ddμ molecule formation on the dμ-atom energy. The first new data were obtained on Λ_f. The experimental value $\Lambda_f > 1.8 \times 10^6\ \mathrm{sec}^{-1}$ (with a 90% confidence) agrees with theoretical data. (auth)

3688 ^{3}He AND ^{4}He TOTAL NEUTRON CROSS SECTIONS IN THE MeV REGION. Goulding, C. A. (Rensselaer Polytechnic Inst., Troy, NY); Stoler, P.; Seagrave, J. D. Nucl. Phys.; A215: No. 2, 253-259(1973).

Total neutron cross sections were measured for ^{3}He and ^{4}He, using a continuous energy source of neutrons. The neutron energy range covered was from less than 1 MeV to 30 MeV. The precision of the cross section magnitude appears to be within 1% over most of the measured energy range. (auth)

3689 DETERMINATION OF THE SINGLET NEUTRON–NEUTRON SCATTERING LENGTH FROM THE ^{2}H(n,p)2n REACTION. Shirato, S. (Rikkyo Univ., Tokyo); Saitoh, K.; Koori, N.; Cahill, R. T. Nucl. Phys.; A215: No. 2, 277-300(1973).

The proton energy differential cross section $d^2\sigma/d\Omega dE_p$ in the ^{2}H(n,p)2n reaction at 14.1 MeV was accurately measured at the mean proton angle $\bar{\theta}_p = 4.0° \pm 2.2°$ with a counter telescope consisting of two Si(Li) surface-barrier detectors and three gas proportional counters. Detailed descriptions on the experiment were presented. In order to extract the $^1S_0$ n–n scattering length α_{nn}, the measured break-up proton spectrum was compared in detail by the χ^2 minimization with the theoretical spectrum calculated in the framework of the Faddeev approach using the separable potentials. As the result, $\alpha_{nn} = -18.31 \pm 0.22$ fm was obtained with the effective range $r_{nn} = 2.84$ fm which was fixed in this analysis. This value of α_{nn} is comparable with the value predicted by Noyes and Lipinski who summarized recently the n-p and p-p scattering parameters. The assumption of charge independence of nuclear forces was evidently violated. The α_{nn} values deduced until now are summarized, and it is discussed that the α_{nn} values extracted from the analysis based on the conventional approximations are unreliable at least at 14 MeV. (auth)

3690 APPLICATION OF SPIN-DEPENDENT SUM RULES FOR SPECTROSCOPIC FACTORS TO TRANSFER REACTIONS ON ^{45}Sc. Clement, C. F. (United Kingdom Atomic Energy Research Establishment, Harwell, Eng.); Perez, S. M. Nucl. Phys.; A213: No. 3, 510-519(1973).

For $f_{7/2}$ neutron transfer on ^{45}Sc the sum rules form a set of 8 equations connecting 16 partial sums of spectroscopic factors for stripping and pick-up to states of different spin. Using existing spin assignments, fits to experimental data enable further spin assignments to be made to states in ^{44}Sc and ^{46}Sc. The fits are consistent with an accuracy of 4% in relative spectroscopic factors. Tests performed on modified sum rules suggest that the absolute normalizations of the relevant DWBA cross sections are accurate to 10% and that there is not more than 10% missing single particle $f_{7/2}$ strength. (auth)

3691 MAGNETIC MOMENT OF THE DEUTERON AND NUCLEON–NUCLEON SPIN–ORBIT POTENTIALS. Mukherjee, S.; Shyam, R. (Physics Department, Banaras Hindu University, Varanasi, India). Phys. Rev. C 8: No. 3, 1149-1151 (Sept 1973).

The change in the magnetic moment of the deuteron arising from the presence of the spin–orbit potential in the nucleon–nucleon interaction has been estimated for the Yale, Hamada–Johnston, and Reid potentials. The present estimates are more close to experiment than those obtained previously from some old fashioned potentials. (auth)

3692 MEASUREMENTS OF THE ^{2}H(p, 2p)n REACTION OVER A LARGE VOLUME OF PHASE SPACE. Rogers, J.G.; Jain, M.; Bronson, J.D. (Cyclotron Institute, Texas A & M University, College Station, Texas 77843). Phys. Rev. C 8: No. 3, 961-971 (Sept 1973).

A kinematically complete measurement of the deuteron breakup cross section has been made using a 39.5–MeV proton beam. The cross section was simultaneously measured at approximately 2000 angle pairs chosen to uniformly sample the entire phase-space volume available to the two protons. A portion of the data in the form of a partial Dalitz plot is compared with a simple model calculation. In the model, the breakup cross section is expressed as an incoherent sum of terms to separately represent the dependence of the cross section on statistical processes, pp quasifree scattering, and nucleon–nucleon final-state interactions. The model calculation does not reproduce the minimum in the partial Dalitz plot, consistent with the previously published hypothesis that the minimum is due to a destructive interference effect. The results of the model calculation are also compared with spectra at a representative set of individual angle pairs. (auth)

3693 POLARIZATION TRANSFER IN THE $^2H(d, p)^3H$ REACTION AT $\theta = 0°$. Clegg, T.B.; Armstrong, D.D.; Hardekopf, R.A.; Keaton, P.W. Jr. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Phys. Rev. C 8: No. 3, 922-928 (Sept 1973).

Measurements of the polarization transfer coefficients $K_y^{y'}$ and $K_{yz}^{x'}$ for the $^2H(d, p)^3H$ reaction at an angle of 0° and for six incident deuteron energies from 6 to 15 MeV are reported. The experimental method used is independent of the knowledge of the analyzing tensor A_{zz} and of current integration. Our measurements of $K_y^{y'}$ agree well with the results of Simmons et al. for the mirror reaction $^2H(d,p)^3He$, supporting their conclusion that the outgoing-nucleon polarization is nearly constant over this energy range but less than that which is calculated for the nucleons in the incident deuterons. (auth)

3694 STUDY of $d + {}^3H$ AND $d + {}^3He$ SYSTEMS WITH THE RESONATING-GROUP METHOD. Chwieroth, F.S.; Brown, R.E.; Tang, Y.C.; Thompson, D.R. (School of Physics, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. C 8: No. 3, 938-950 (Sept 1973).

The one-channel resonating-group method, together with a phenomenological imaginary potential, is used to study the $d + {}^3H$ and $d + {}^3He$ systems. Our calculations show that, because of the Pauli exclusion principle, these systems possess the following rather interesting feature: In the $s = 3/2$ state they behave similar to the $d + \alpha$ system, whereas in the $s = 1/2$ state they behave more like the $^3He + {}^4He$ system. Phase shifts are computed up to $l = 7$, and an R-matrix analysis of these phases indicates that there are a large number of levels with resonance energies below 12 MeV. Differential scattering and total-reaction cross sections are compared with experimental data at several c.m. energies from about 2 to 14 MeV. This comparison shows that the introduction of an odd-even orbital-angular-momentum dependence into the imaginary potential can improve the agreement of the calculation with experiment. (auth)

3695 INVESTIGATION OF OFF-SHELL EFFECTS IN TRITON BINDING-ENERGY CALCULATIONS WITH NONLOCAL-CORE NUCLEON-NUCLEON POTENTIALS. Zohni, O. (Institute of Theoretical Physics, Warsaw University, Warsaw, Poland (Received 13 April 1973)). Phys. Rev. C 8: No. 3, 1164-1166 (Sept 1973).

Using the Faddeev formalism, a study of the off-energy-shell variation of the triton binding energy (E_t) is made. The results are indicative of the insensitivity of E_t to the off-shell differences associated with the various nucleon-nucleon potentials considered, which are equivalent on the energy shell and vary mainly in the shape of their repulsive cores for $r \lesssim 0.5$ fm. (auth)

3696 PROTON-PROTON FINAL-STATE INTERACTION IN THE $^2H(p, n)2p$ REACTION. Davis, J.C.; Anderson, J.D.; Grimes, S.M.; Wong, C. (Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Rev. C 8: No. 3, 863-869 (Sept 1973).

Neutron spectra from the $^2H(p, n)2p$ reaction have been measured at nine proton energies between 16 and 26 MeV. The high-energy portions of the neutron spectra taken at a laboratory angle of 3.5° have been analyzed with impulse approximation calculations of the proton-proton final-state interaction to extract the proton-proton scattering length. The average value of the scattering length determined from these measurements is within approximately 1 fm of the −7.8-fm result of pp scattering but is not independent of the details of the comparison of experimental and calculated spectra. Experimental requirements for a determination of the neutron-neutron scattering length from the $^2H(n, p)2n$ reaction are discussed. (auth)

3697 STUDY OF PROMINENT TWO-BODY PROCESSES IN THE D(p, 2p)n REACTION AT 30.3 MeV. Margaziotis, D.J.; Epstein, M.B. (California State University, Los Angeles, California 90032); Šlaus, I.; Anzelon, G.; Carlson, R.F.; Ebenhöh, W. Phys. Rev. C 8: No. 3, 870-876 (Sept 1973).

The D(p, 2p)n reaction has been studied at $E_p = 30.3$ MeV at kinematic conditions where either final-state interactions or quasifree scattering predominate, and at kinematic conditions where the kinematic domains of these two processes are near each other. Data were obtained at 25°-91°, 30°-80°, 37.5°-68°, 25°-25°, 30°-30°, 42.5°-42.5°, 24°-60°, 30°-56°, 35°-43°, 37°-47°, 63°-30°, 55°-40°, and 49.5°-49.5°. The results are compared with predictions of the Amado model and, in general, there is good agreement between the model and the data. (auth)

3698 HADRON-NUCLEUS SCATTERING. Qureshi, H. M. Amherst, MA; Univ. of Massachusetts (1973). 100p. University Microfilms Order No. 73-22,811.

Thesis (Ph. D.).

Most of the recent hadron-nucleus scattering calculations have used either the Glauber approximation or optical model potentials, particularly the Kisslinger model. Similar calculations are done by directly evaluating Watson's multiple scattering series. This is done within the framework of three basic approximations, namely the impulse approximation, the coherent approximation and the no recoil approximation. These assumptions are the same as for the Glauber approximation. However, exact single particle Green's functions were used without making small angle approximations. New recursion relations were derived that enable one to evaluate Watson's multiple scattering series to any order of scatterings. In the region where $qR \lesssim 10$, this method is found quite reasonable. The results of the calculations are compared with those of the Glauber approximation. Both sets of results are compared with the experimental data in whatever instances it is available in the literature. The calculations of elastic differential cross sections for $\pi^- - {}^4He$ and $\pi^- - {}^{12}C$ near the (3/2, 3/2) resonance energy, for $\pi - {}^{12}C$ at low energies, and for 1 GeV proton − ^4He are presented. It is found that the coherent approximation makes the usual optical model series with A(A−1)(A−1) . . . and A.A.A. . . . terms diverge in the region beyond first minimum. Thus one can not use the coherent approximation without suppressing all the rescattering terms. Both the methods—Watson's multiple scattering series and the Glauber approximation—give an adequate description of the data at least up to the first minimum in the medium energy range. Beyond the region of the first minimum, the fits can possibly be improved if proper nuclear correlations are included and more realistic forms of the two body amplitudes which incorporate properly the on-shell and off- the shell behavior are used. However the Glauber approximation seems to give surprisingly excellent agreement with the experimental data, even with the use of simple minded models of nuclear densities and two body scattering amplitudes. In the higher energy case (1 GeV p-^4He) the differences between these two methods are quite insignificant indicating that in the high energy limit both the methods tend to Born approximation. In short the value of the methods lies not in the direct comparison of experimental data but in the study of the relations among various theoretical approaches. (Diss. Abstr. Int., B)

3699 EXACT ANALYTICAL SOLUTION TO THE TWO-BODY PROBLEM WITH A SEPARABLE (NON-LOCAL) CENTRAL AND TENSOR INTERACTION. Lee, C. E. Boulder, CO; Univ. of Colorado (1973). 419p. University Microfilms Order No. 73-23,275.

Thesis (Ph. D.).

A two-nucleon, nonrelativistic, spin-dependent and nonlocal interaction with a repulsive hard core (of diameter a) is investigated, and exact analytical solutions to the Schrödinger wave equation are obtained for all angular momentum states. Using a complete orthonormal set of functions on the interval (a,∞) the spatial and momentum representation wave functions are determined using contour integration techniques. The known identification of Blatt-Biedenharn, and also Stapp "bar," phase shifts from asymptotic spatial solutions permits determination of all phase-shift parameters in terms of known, explicitly displayed functions. The wave-function solutions, by further contour integration techniques, are also used in the explicit analytical determination of the deuteron bound-state condition, RMS radius and quadrupole moment. The low-energy expansions of the S-wave phase-shift expressions for $k \cot \delta$ result in a determination of the scattering length, effective range and shape-dependent parameters in terms of the core radius, and the strengths and ranges of the central and tensor interaction. Rapid computational methods using continued fractions to evaluate exponential integrals and series expressions with complex arguments are developed. Preliminary numerical calculations of the parameters of this exact analytical model are included. (Diss. Abstr. Int., B)

3700 STATES OF ^5He AND ^8Be FROM THE REACTION $^7Li + d$. Evaluation of $\alpha - \alpha$-Coincidence Spectra. Kamke, D. (Univ., Bochum, Ger.). Z. Phys.; 263: No. 3, 251-266(1973).

Nuclear reactions of deuterons with ^7Li were used in order to determine properties of the intermediate nuclei ^8Be and ^5He. Of particular interest are locations and widths of the ground state and first excited state of ^5He, and of the second excited state of ^8Be. In a complete $\alpha - \alpha$-coincidence spectrum, however, overlapping of the coincident rates restricts very much the evaluation of such spectra. Particularly important is the velocity of the overall center of mass which may cause unfavorable conditions for reliable determinations of the wanted data. (GE)

3701 TWO-BODY PHOTODISINTEGRATION OF ^3He. Ticcioni, G.; Gardiner, S. N.; Matthews, J. L.; Owens, R. O. (Univ. of Glasgow). Phys. Lett.; 46B: No. 3, 369-371(1 Oct 1973).

The differential cross section for the reaction $^3He(\gamma,d)^1H$ was measured for photon energies 11 to 65 MeV. The results are compared with previous measurements and with a recent theoretical calculation. (auth)

3702 DIRECT AND RESONANT CAPTURE OBSERVED IN THE $^3H(\tau,\gamma)^6Li$ REACTION. Ventura, E. (Stanford Univ., CA);

Calarco, J. R.; Meyerhof, W. E.; Young, A. M. Phys. Lett.; 46B: No. 3, 364-366(1 Oct 1973).

A direct capture model is used to calculate the $^{3}H(\tau,\gamma)^{6}Li$ cross section. The result for the ground-state cross section is in very good agreement with the data. The calculation for the cross section for the first excited state is in good agreement with the shape and angular dependence of the measured cross section at lower energies. Above $E_\tau = 10$ MeV a large discrepancy indicates a nondirect contribution. This is interpreted as a resonance in the compound nucleus ^{6}Li with a configuration other than $^{3}He + {}^{3}H$. (auth)

3703 PION–DEUTERON SCATTERING IN THE Δ(1236) ENERGY REGION AS A THREE-BODY PROBLEM. Myhrer, F.; Koltun, D. S. (Univ. of Rochester, NY). Phys. Lett.; 46B: No. 3, 322-324(1 Oct 1973).

Pion–deuteron scattering in the first π-N resonance energy region is studied in a three-body model based on Faddeev's equations. The effects of multiple scattering, nuclear binding, and virtual excitation of the target, on the energy behavior of the cross section are discussed. (auth)

3704 EFFECTS OF IMAGINARY POTENTIALS ON SPURIOUS RESONANCES IN RESONATING-GROUP CALCULATIONS. Chwieroth, F. S.; Tang, Y. C.; Thompson, D. R. (Univ. of Minnesota, Minneapolis). Phys. Lett.; 46B: No. 3, 301-303(1 Oct 1973).

By studying the coupled-channel $d + {}^{3}He$ and $p + \alpha$ resonating-group calculation, it is found that the introduction of phenomenological imaginary potentials is a simple way to eliminate spurious resonances from resonating-group and perhaps other microscopic reaction calculations. (auth)

3705 PION PRODUCTION IN THE REACTION $pd \rightarrow t\pi$. Bhasin, V. S.; Duck, I. M. (Rice Univ., Houston, TX). Phys. Lett.; 46B: No. 3, 309-312(1 Oct 1973).

The Yao–Barry model is extended to the reaction $pd \rightarrow t\pi$ and provides a description of the cross section for incident proton energies from 340 to 670 MeV in terms of a single parameter, the triton nd wave function evaluated at the origin. The results are competitive with the predictions of the Ruderman model for the energy dependence of the forward cross section and show much larger backward cross sections. (auth)

3706 0^{+} STATE OF ALPHA PARTICLE IN A MODEL WITH SEPARABLE POTENTIAL. Narodetskii, I. M.; Gal'pern, E. S.; Lyakhovitskii, V. N. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 12, 479-483(20 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 12, 693-698(20 Jun 1973).

A new approach to the four-nucleon problem is considered, based on the use of multiparticle integral equations. The first calculations of this kind for 0^{+} states of an alpha particle with allowance for the spin dependence of the nucleon–nucleon interaction are presented. (JFP)

3707 POSSIBILITY TO DETERMINE THE $\pi^{-3}He^{3}H$ COUPLING. Dumbrais, O. V.; Nikitiu, F.; Shcherbakov, Yu. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 2, 327-332(Aug 1973). (In Russian).

A possibility is investigated to determine the $\pi^{-}He^{3}H^{3}$ coupling constant from the experimental data on the $\pi^{+}He^{3}$ scattering at 100 MeV. The method is based on an extrapolation of $d\sigma/d\Omega$ to the H^{3} pole and uses a conformal mapping. The accuracy of the available experimental data on the elastic πHe^{3} scattering is not sufficient for getting information on the coupling constant. (auth)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 3348, 3679, 3698, 3700, 3781, 3784, 3815, 3881, 3882, 3921, 3939, 4089, and 4380.

3708 (JINR-D6-7094, pp 40-41) DECAY OF THE PHOTO GIANT RESONANCE OF ^{7}Li AND ^{9}Be NUCLEI. Aswad, A. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Kissener, H. R.; Eramzhian, R. A.; Jaeger, H. U. 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3709 (JINR-D6-7094, pp 55-56) (α,t) REACTIONS ON NUCLEI OF B AND ^{13}C. Levedev, V. M.; Markman, V. G.; Spasskii, A. V.; Teplov, I. B. (Moscow State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3710 (NP-19869) INVESTIGATION OF PION-INDUCED NUCLEAR REACTIONS BY MEANS OF SPECTROSCOPY OF THE RESULTING γ QUANTA. Boschitz, E. T.; Bradley, G.; Engelhardt, D.; Lewis, C.; Ullrich, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Jul 1972. 42p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

Nuclear γ-rays following the absorption of negative pions on ^{12}C, ^{14}N and ^{16}O were studied. The measurements were performed at the μ-channel of the CERN SC using a 40 cm^{3} Ge(Li) and a 5″ × 5″ NaI-detector. γ-lines between 0.5 and 8 MeV could be identified in the γ-ray spectra and were attributed to specific final states. For the oxygen target absolute yields were determined by a method utilizing muonic x-rays from lead. From the Doppler broadening of the most prominent line from the $^{16}O(\pi^{-},2n)^{14}N$ reaction, the momentum distribution of the absorbing nucleon pair was determined. In addition (n-γ) coincidence measurements were performed with the NaI-detector operating in conjunction with a large area ($2m^{2}$) neutron time of flight spectrometer. This system allowed a measurement to be made of the neutron energy distribution associated with γ-lines in ^{14}N. (auth)

3711 (USNDC-7, pp 5-6) THICK TARGET NEUTRON YIELDS FROM ^{3}He-BOMBARDMENT OF ^{9}Be FOR NEUTRON, RADIATION-THERAPY. Kuchnir, F. T.; Skaggs, L. S.; Elwyn, A. J.; Mooring, F. P. (Argonne National Lab., IL). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3712 (USNDC-7, pp 102-104) TOTAL INELASTIC CROSS SECTIONS FOR Li–Li AND Li–Be REACTIONS. Norbeck, E.; Poling, J. E.; Von Behren, P. L. (Univ. of Iowa, Iowa City). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3713 (USNDC-7, pp 193-194) STATES IN ^{12}B OBSERVED IN NEUTRON ELASTIC SCATTERING FROM ^{11}B. Nelson, C. E.; Hausladen, S. L.; Lane, R. O. (Ohio Univ., Athens). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3714 (USNDC-7, pp 193; 195-197) STUDY OF THE LEVEL STRUCTURE OF ^{11}B. Hausladen, S. L.; Nelson, C. E.; Lane, R. O. (Ohio Univ., Athens). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3715 (USNDC-7, pp 275; 277) POLARIZATION OF NEUTRONS IN n–^{16}O SCATTERING. (Yale Univ., New Haven). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3716 (USNDC-7, pp 276; 278) POLARIZATIONS OF GROUND-STATE PHOTONEUTRONS FROM THE REACTIONS $^{12}C(\gamma,\vec{n}_0)^{11}C$ AND $^{16}O(\gamma,\vec{n}_0)^{15}O$. (Yale Univ., New Haven). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3717 NUCLEAR STRUCTURE CALCULATIONS WITH REALISTIC TWO BODY FORCES. Maripuu, S. (Michigan State Univ., East Lansing). pp 63-89 of Fifth Symposium on the Structure of Low-Medium Mass Nuclei. Davidson, J. P. (ed.). Lexington, KY; University Press of Kentucky (1973).

From 5th symposium on the structure of low medium mass nuclei; Lexington, Kentucky, USA (26 Oct 1972). See CONF-721066-.

The Sussex matrix elements are used to derive effective interactions in the model space of the p-, sd-, and upper part of the sd-shell including some pf excitations. The structure of A = 6 to 13 nuclei (including magnetic dipole moments and energy-level properties), energy levels of A = 18 to 22 nuclei, and configuration mixing of the df and dp multiplets of ^{38}Cl (including the energy spectra, binding energies, excitation energies, M1 transition strengths, multiplets, and spectroscopic factors) are discussed. (JFP)

3718 ISOSCALAR MAGNETIC MOMENTS IN LIGHT NUCLEI. Endt, P. M. (State Univ., Utrecht). pp 122-123 of Fifth Symposium on the Structure of Low-Medium Mass Nuclei. Davidson, J. P. (ed.). Lexington, KY; University Press of Kentucky (1973).

From 5th symposium on the structure of low medium mass nuclei; Lexington, Kentucky, USA (26 Oct 1972). See CONF-721066-.

The constancy of the g-factor for the isoscalar contribution to magnetic moments found from multicomponent wave functions from shell-model calculations for the magnetic dipole moment is discussed. (JFP)

3719 DOPPLER SHIFTS WITH GAS BACKING. Donahue, D. J. (Univ. of Arizona, Tucson). pp 215-224 of Fifth Symposium on the Structure of Low-Medium Mass Nuclei. Davidson, J. P. (ed.). Lexington, KY; University Press of Kentucky (1973).

From 5th symposium on the structure of low medium mass nuclei; Lexington, Kentucky, USA (26 Oct 1972). See CONF-721066-.

The Doppler shift attenuation method for measurements of mean lives of nuclear states is discussed for several experiments in which nuclei recoil in a gas; thus, depending on the gas pressure used, mean lives from a few picoseconds up to nanoseconds can be measured. Iron-55, oxygen-17, fluorine-17, and calcium-44 are considered. (JFP)

3720 POLARIZED BEAMS IN NUCLEAR SPECTROSCOPY. Glavish, H. F. (Stanford Univ., CA). pp 233-271 of Fifth Symposium on the Structure of Low-Medium Mass Nuclei. Davidson, J. P. (ed.). Lexington, KY; University Press of Kentucky (1973).

From 5th symposium on the structure of low medium mass nuclei; Lexington, Kentucky, USA (26 Oct 1972). See CONF-721066-.

Two specific applications of polarized beams in nuclear spectroscopy are discussed. These are the study of giant dipole states of nuclei observed with the polarized proton capture reactions, and the study of particle–gamma correlations following a nuclear reaction that is initiated by a polarized incident beam. Several examples from previous experimental work are described. (JFP)

3721 NOTE ON THE SINGLE-CLOSED-SHELL NUCLEI. Sandhu, T.S.; Rustgi, M.L. (Department of Physics, State University of New York, Buffalo, New York 14214). Phys. Rev. C 8: No. 3, 1152-1153 (Sept 1973).

Assuming the existence of a spherical ^{16}O core, self-consistent Hartree-Fock, Hartree-Fock-Bogoliubov, and spherical BCS calculations for the even oxygen isotopes are carried out for Kuo-Brown and a number of other effective interactions. In agreement with the finding of Chandra and Rustgi for the even Ca and Ni isotopes, the spherical BCS approximation is found to yield the actual minimum-energy solution for the even oxygen isotopes as well. The present calculation thus adds credibility to the general inferences made by Chandra and Rustgi that, for single-closed-shell structures, the self-consistent shape will always be spherical BCS. (auth)

3722 PRODUCTION OF ^7Be, ^9Be, AND ^{10}Be IN THE SPALLATION OF ^{13}C BY PROTONS OF 150 AND 600 MeV. Raisbeck, G. M.; Lestringuez, J.; Yiou, F. (Centre National de la Recherche Scientifique, Orsay, France). Nature (London) Phys. Sci.; 244: No. 132, 28-30(9 Jul 1973).

Cross sections were determined for the production of Be isotopes from the spallation of highly enriched ^{13}C targets by protons of 150 and 600 MeV. The reasons for undertaking this work are two-fold. First, although ^{13}C is a relatively minor component of C in the solar system, the interstellar medium, and many stars, there are certain astrophysical environments in which it may be expected to play an important role. Exploding stars are considered as likely candidates as cosmic-ray sources, and it is conceivable that a significant fraction of cosmic-ray C could be ^{13}C. It is thought that the observed cosmic-ray C is predominantly monoisotopic and probably ^{12}C, but even if the cosmic-ray C is pure ^{12}C spallation of heavier primary nuclides will result in a nonnegligible contribution of secondary ^{13}C, that can undergo further nuclear reactions in its passage through the interstellar medium. Whilst the extent of ^{13}C rich matter in the universe is not clear, it was thought interesting to investigate the implications that might follow from spallation processes on such material, and it is thought that the results might provide a test for theoretical models that attempt to describe the nuclear spallation mechanism. Details are given of the experimental technique adopted, and results are summarized in tabular form. Samples of the enriched ^{13}C were irradiated in the synchrocyclotrons at Orsay and Cern, with integrated fluxes of $\sim 5 \times 10^{18}$ protons. A sputtering mass spectrometer was used for analysis of Be isotopes, having measured the absolute ^7Be cross section by radiochemical techniques. It was found that the distribution of Be product isotopes differed substantially for ^{12}C and ^{13}C targets, and the larger N/Z ratio of ^{13}C was reflected by a larger average N/Z of the product species: the magnitudes of the shift was surprising. Models are discussed. Implications for the use of the long lived ^{10}Be isotope as a "clock" in cosmic ray studies are also discussed. It is hoped to extend the studies also to Li and B production. (UK)

3723 DETERMINATION OF THE MAGNETIC MOMENT OF THE ^{14}N GROUND STATE FROM ONE-NUCLEON TRANSFER DATA. Charzewski, C. V. (Univ., Frankfurt am Main); Dreizler, R. M.; Fortune, H. T. Nucl. Phys.; A213: No. 3, 429-435(1973).

The processing by sum rules of the experimental spectroscopic factors for one-particle transfer concerning ^{14}N yields enough information to calculate the magnetic moment of the ^{14}N ground state to a good approximation. (auth)

3724 ELECTROEXCITATION OF ^{16}O LEVELS NEAR 10 MeV EXCITATION. Bergstrom, J. C.; Auer, I. P.; Kline, F. J.; Caplan, H. S. (Univ. of Saskatchewan, Saskatoon). Nucl. Phys.; A213: No. 3, 609-628(1973).

The electromagnetic form factors of the 2^+ (9.85 MeV) and 4^+ (10.34 MeV) states in ^{16}O were measured for momentum transfers between 0.7 and 1.2 fm^{-1}. The results for the 4^+ state are compared with the predictions of the three-component Brown-Green model. The present data and those of a previous electron scattering experiment are interpreted in the framework of a two-component model in order to obtain rough estimates of the β_2 and β_4 deformation parameters. Predictions for the 2^+ (9.85 MeV) level form factor, within the context of an axially asymmetric rotor model, are compared with the experimental form factor. It is found that this model gives a poor description of the data. Radiative widths and transition radii were determined by a Helm model analysis. (auth)

3725 FORM FACTORS OF THE 2^+ (11.52 MeV) AND 0^+ (12.05 MeV) LEVELS OF ^{16}O. Bergstrom, J. C.; Auer, I. P. (Saskatchewan Accelerator Lab., Saskatoon, Can.). Nucl. Phys.; A215: No. 2, 232-242(1973).

The form factors for the electroexcitation of the 2^+ (11.52 MeV) and 0^+ (12.05 MeV) states of ^{16}O were measured in the momentum transfer range q = 0.7 –1.15 fm^{-1}. The radiative width of the 2^+ state and the monopole matrix element of the 0^+ state for ground state transitions were determined as 0.61 ± 0.02 eV and 4.03 ± 0.09 fm^2, respectively. The 0^+ levels at 6.05, 12.05 and 14.00 MeV are found to saturate about 19% of an isoscalar monopole sum rule. The form factor of the 0^+ (12.05 MeV) level is compared with the doorway dominance scheme of Fallieros et al. Comparison of the form factors is made with the predictions based on the three-component Brown-Green model. (auth)

3726 SU(4) BREAKING, ALLOWED TRANSITIONS, AND TOTAL MUON CAPTURE RATES IN NUCLEI. Bernabeu, J. (CERN, Geneva); Cannata, F. Nucl. Phys.; A215: No. 2, 411-423(1973).

Muon capture rates in light nuclei are studied and it is shown that one can evaluate them in a model-independent way by correcting the Primakoff closure approximation to the first order in the neutrino energy dependence. In this framework the interplay between the existence of allowed transitions and SU(4) breaking is analyzed. In the correction to the first order in the neutrino energy dependence by a sum rule, Majorana and SU(4) breaking potentials are taken into account. The method is also applied to single multipolar transitions, in particular for the dipole transitions. General considerations are illustrated for ^6Li and ^{12}C by explicit calculations. The stability of the results varying the mean neutrino energy allows the use of capture rates as a very sensitive tool to investigate the configuration mixing of the target because the corrective term is connected to spectroscopic information using directly the matrix elements of the effective potentials. (auth)

3727 MUON CAPTURE BY ^{14}N. Kissener, H. R. (Zentralinstitut fuer Kernforschung, Dresden); Aswad, A.; Jaeger, H. U.; Eramzhian, R. A. Nucl. Phys.; A215: No. 2, 424-428(1973).

Excitation and decay of the giant resonance of ^{14}C in muon capture by ^{14}N are considered. A characteristic feature of this process is the large yield of two neutrons and the low yield of charged particles. The allowed transitions are included in the calculation and lead to noticeable neutron emission. (auth)

3728 QUASI-FREE SCATTERING IN THE $^6Li(d,dd)^4He$ REACTION AT LOW BOMBARDING ENERGIES. Miljanic, D. (Rice Univ., Houston, TX); Zabel, T.; Liebert, R. B.; Phillips, G. C.; Valkovic, V. Nucl. Phys.; A215: No. 2, 221-231(1973).

Deuteron-deuteron quasi-free scattering contributions in the $^6Li(d,dd)^4He$ reaction were measured for deuteron bombarding energies 6-11 MeV. The plane wave impulse approximation does not give a satisfactory description of the measured spectra. The introduction of a radial cut-off gives a better agreement in the shape and absolute magnitude. Extracted clustering probabilities and widths of momentum distributions are compared with results from other quasi-free scattering reactions on ^6Li. (auth)

3729 POSITIVE-PION ABSORPTION BY C NUCLEI AT 130 MeV. Bellotti, E.; Cavalli, D.; Matteuzzi, C. (Univ., Milan). Nuovo Cim.; 18A: No. 1, 75-93(1 Nov 1973).

About 1500 absorption events of π^+ in flight (~ 130 MeV of kinetic energy) have been studied in a propane bubble chamber. The corresponding cross section is (189 ± 19) mb/C nucleus, about one half of the total inelastic cross section. The absorption on two nucleons with low excitation of the residual nucleus seems to be responsible for 10% of the $\sigma_{\text{tot abs}}$ only, while the capture by an α-cluster seems to be more important (~40% of the total). The events have been analyzed according to their charged-prong multiplicity. Data concerning two-prong events agree with the theoretical predictions calculated by assuming the dominance of the reaction $\pi^+(np) \rightarrow pp$ and by using the impulse approximation model; however a large fraction of them (~40%) is due to the absorption on an α-cluster: $\pi^+ (\alpha) \rightarrow ppd$ with very-low-energy transfer to the deuteron. Three-prong events have been interpreted as due to the process $\pi^+(\alpha) \rightarrow pppn$ and qualitative agreement between data and theory has been found. Some data on many-prong events are also reported. (auth)

3730 STUDY OF NEUTRON AND ALPHA-PARTICLE TRANSFER MECHANISMS IN THE ^{7}Li(d,t)^{6}Li REACTION. Werby, M.F.; Edwards, S. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). Phys. Rev. C 8: No. 3, 978-987 (Sept 1973).

The ^{7}Li(d, t)^{6}Li reaction is analyzed at a bombarding energy of 12 MeV using a finite-range, multi-interaction, two-mode distorted-wave-Born-approximation (DWBA) formalism. Extracted direct-mode spectroscopic factors agree with theoretical predictions only when knockout components are included in the analysis, showing the usual DWBA cancellation assumption to be inappropriate for this reaction. Contributions from the exchange-mode mechanisms are found to be necessary for a satisfactory description of the complete angular distribution. It is also found that two of the three optical-model-parameter sets used can be eliminated and thus the optical-model ambiguties, resolved by examining the exchange-mode spectroscopic factors. (auth)

3731 REACTION ^{6}Li(p,pt) AT 590 MeV. Dollhopf, W.; Lunke, C.; Perdrisat, C.F. (Physics Department, College of William and Mary, Williamsburg, Virginia 23185); Kitching, P.; Olsen, W. C.; Priest, J. R.; Roberts, W. K. Phys. Rev. C 8: No. 3, 877-880 (Sept 1973).

The cross section ($d^5\sigma/d\Omega_p d\Omega_t dT_p$) for the reaction ^{6}Li(p, pt) has been measured in a kinematically complete experiment. The energy resolution did not allow for an identification of the final-state residual nucleus. The cross-section data obtained, when analyzed in terms of the recoil momentum of the three-nucleon residual system, has the shape characteristic of an S state for the relative motion of the triton. If the cross section is fitted with a Gaussian the width at 1/e is $\Gamma = 100 \pm 20$ MeV/c, and the cross section at zero recoil is 490 ± 120 nb/sr^3 MeV. The width observed is twice as large as obtained in previous, lower-energy experiments, but only slightly larger than predicted by ^{6}Li-cluster-model calculations. (auth)

3732 ISOSPIN MIXING OF STATES IN ^{6}Li. Bray, K.H.; Cameron, J.M.; Fearing, H.W.; Gill, D.R.; Sherif, H.S. (Nuclear Research Centre, The University of Alberta, Edmonton, Canada T6G 2J1). Phys. Rev. C 8: No. 3, 881-887 (Sept 1973).

Isospin mixing in the mass $A = 6$ system is examined by measuring the deuteron decay branch of the ^{6}Li (5.36-MeV; $T = 1$) state. The mixing to be expected due to the Mott-Schwinger part of the Coulomb interaction is calculated. The measured spectra do not show any positive evidence for deuteron decay of the ^{6}Li (5.36-MeV; $T = 1$) state. However, the experimental upper limit for possible isospin mixing is still appreciably larger than that expected from the Mott-Schwinger interaction. (auth)

3733 ELASTIC MUON-CARBON SCATTERING IN A LOW-MOMENTUM-TRANSFER REGION. Sanford, T.; Childress, S.; Dugan, G.; Lederman, L.M.; Price, L.E. (Columbia University, New York, New York 10027). Phys. Rev. C 8: No. 3, 896-908 (Sept 1973).

Elastic scattering of 190-MeV/c muons has been measured to ≈ 1% in the angular range 140 mrad $\leq \theta \leq$ 590 mrad, corresponding to invariant four-momentum transfers 0.016 fm^{-2} $\leq q^2 \leq$ 0.33 fm^{-2}. Magnetostrictive wire spark chambers were used to measure the incident momentum and scattering angle. A comparison is made with electron scattering experiments which extend down in q^2 to 0.02 fm^{-2}. A change of slope of the carbon form factor in the range below 0.05 fm^{-2} would indicate unexpected structure in the outer regions of the nuclear charge distribution. Disagreement with electron scattering where both processes are measured would indicate a breakdown of muon-electron universality. No such effects are observed. (auth)

3734 ENERGY LEVELS OF ^{14}N FROM THE ELASTIC SCATTERING OF α PARTICLES BY ^{10}B. Mo, T.; Weller, H.R. (Department of Physics, University of Florida, Gainesville, Florida 32601). Phys. Rev. C 8: No. 3, 972-977 (Sept 1973).

The level structure above 13-MeV excitation energy in ^{14}N was investigated through the reaction ^{10}B(α, α)^{10}B in the energy range from E_α = 2.0 to 4.3 MeV. Excitation functions for elastically scattered α particles were measured in 20-keV steps at six c.m. angles of 67.8, 89.7, 113.5, 141.8, 154.9, and 169.1°. Besides the two strong resonances observed at $E_\alpha \simeq$ 2.21 and 4.26 MeV, respectively, two additional resonances were required to fit the excitation functions. An R-matrix calculation was used to obtain spin and parity assignments of 3^+, 1^+, 3^+, and 2^- to the levels at excitation energies of E_x = 13.19, 13.72, 14.25, and 14.66 MeV, respectively. The partial widths of α-particle decay and total widths of these states were also determined. In addition, the excitation function from E_α = 1.4 to 2.0 MeV was measured at $\theta_{\text{c.m.}}$ = 89.7°, and no obvious resonances were observed in this energy region. Possible correlations of the strong α-particle levels to the α-particle core-excited threshold-state model are also discussed. (auth)

3735 f-WAVE DECAY OF THE 8.9-MeV LEVEL IN ^{13}N. Bernstein, E.M.; Ramirez, J.J.; Baumann, L.; Soga, M. (Western Michigan University, Kalamazoo, Michigan 49001). Phys. Rev. C 8: No. 3, 1162-1163 (Sept 1973).

Proton spin-flip in ^{12}C(p, p$_1$)^{12}C (2^+, 4.44 MeV) has been measured in the region of the 8.9-MeV $1/2^-$ level in ^{13}N. The inelastic decay is predominately by $f_{5/2}$ waves. The reduced width in the $f_{5/2}$ channel is about equal to the single-particle limit. (auth)

3736 ELECTRO-EXCITATION OF SOME BOUND STATES OF ^{15}N AND ^{39}K. Fleming, D. M. Jr. Amherst, MA; Univ. of Massachusetts (1973). 282p. University Microfilms Order No. 73-22,797.

Thesis (Ph. D.).

Bound states in ^{15}N and ^{39}K were studied by inelastic electron scattering experiments performed at the Kelvin Laboratory and at the Mark III electron linear accelerator at Stanford University. For the nitrogen experiment, inelastic spectra were measured for incident electron energies between 59 and 110 MeV and scattering angles between 97.5 and 155°. The data were taken at fixed momentum transfer and variable scattering angle so that a model-independent separation of the square of the inelastic form factor into its longitudinal and transverse components could be performed. The range of momentum transfers spanned by the data was 0.47 fm^{-1} to 0.87 fm^{-1}. A heavy-liquid ammonia target was used in this experiment. Reduced transition probabilities and transition radii were extracted for the levels at 5.27 MeV ($5/2^+$), 6.32 MeV ($3/2^-$), 7.30 MeV ($3/2^+$), 7.56 MeV ($7/2^+$), 9.16 MeV ($3/2^-$), and 9.76 MeV ($5/2^-$). The data were analyzed in the plane-wave born-approximation. For the potassium experiment, the incident electron energy was 150 MeV and inelastic spectra were measured for scattering angles from 50 to 110° in 5° intervals. This corresponds to a momentum transfer range of 0.6 fm^{-1} to 1.28 fm^{-1}. Reduced transition probabilities and transition radii were extracted for the first four excited states in ^{39}K at 2.53 MeV ($1/2^+$), 2.82 MeV ($7/2^-$), 3.02 MeV ($3/2^-$), and 3.60 MeV ($9/2^-$). The data were analyzed by using a distorted-wave born-approximation calculation. The applicability of the weak-coupling model to excited states in ^{15}N and ^{39}K was investigated. For the case of ^{15}N, the experimental evidence was not consistent with the predictions of the weak-coupling model. Since two of the states in the weak-coupling multiplet in ^{39}K were not resolved from nearby levels, it was concluded that additional experimental data was required before any definite conclusions could be drawn as to whether the weak-coupling model applied to the states in ^{39}K. (Diss. Abstr. Int., B)

3737 EXPERIMENTAL STUDY OF THE ^{16}O(^{16}O,^{12}C)^{20}Ne REACTION FROM 17.4 TO 29.8 MeV C.M. ENERGY. Sink, D. A. Bloomington, IN; Indiana Univ. (1972). 203p. University Microfilms Order No. 73-23,003.

Thesis (Ph. D.).

Experimental observations have shown that the cross section for the elastic scattering of ^{16}O by ^{16}O exhibits energy variations characterized by regularly spaced gross structures (~ 2 MeV wide) with peak-to-valley ratios as great as 20 : 1. These data were interpreted as resulting from the formation of quasi-molecular resonances in the ^{16}O + ^{16}O system. If such an interpretation is valid, these resonances should be seen in the yield of reaction channels closely coupled to the elastic channel. With the above in mind, the experimental study of the ^{16}O(^{16}O, ^{12}C)^{20}Ne reaction was undertaken. Experimental data in the form of differential cross sections were obtained for reactions leading to the first three states in ^{20}Ne in the range from 17.3 to 29.7 MeV c.m. energy. Excitation functions for each state at three angles and angular distribution are selected energies covering an angular range from 16 to 90° c.m. were measured. The results are characterized by broad resonance-like structures approximately 1.5 to 2.0 MeV wide on which narrower structures are superimposed. The angular distributions are not strongly forward peaked and tend to show little or no structure for the 1.63 and 4.25 MeV states of ^{20}Ne while those for the g.s. reaction exhibit strong diffraction-like structure. The correlations seen in the CN levels are believed to be further enhanced by the formation of the molecular resonances. This enhancement is due to molecular resonances of a definite spin feeding the CN levels of the same spin resulting in a type of doorway phenomena. The evidence for this conclusion is seen for the reactions studied in which the strength of the correlations is related to the strength of the molecular resonances. These resonances show up only weakly in the g.s. reaction data and strongly in the data for the 1.63 to 4.25 MeV states where the resonance structures have peak-to-valley ratios as large as 10:1. It is believed that the g.s. reaction which analyzed by a phenomenological direct-reaction theory has an appreciable yield due to a simple nonresonance direct interaction. The above data and its subsequent analysis are believed to provide the additional evidence for the existence of molecular resonances in the ^{16}O + ^{16}O reaction systems. (Diss. Abstr. Int., B)

3738 SPIN-DEPENDENT EFFECTS IN GIANT-RESONANCE EXCITATION OF DOUBLY-CLOSED-SHELL NUCLEI. Cannata, F.; Ros, J. (Oxford Univ.). Lett. Nuovo Cim.; 8: No. 7, 466-470(13 Oct 1973).

Some numerical estimates are given in the particle–hole framework especially for muon capture, photoproduction of charged pions, and the scattering of pions on oxygen-16. (JFP)

3739 TOTAL NEUTRON CROSS SECTION OF BERYLLIUM. Gerasimov, V. F.; Zenkevich, V. S.; Moskalev, S. S.; Markov, D. A.; Kheruvimov, A. V. (Inst. of Atomic Energy, Moscow). pp 140-144 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565–P1.

The total neutron cross sections of beryllium samples with different textures were measured on the time-of-flight neutron spectrometer at the Kurchatov Institute linac in the neutron energy range 0.005 to 10 eV. A strong dependence of the total cross section on the sample texture was observed. The cross-section value averaged over a Maxwell spectrum with different effective temperatures was calculated. (2 figures) (auth)

3740 CROSS SECTION FOR THE REACTION ^{12}C(n,p)^{12}B NEAR THRESHOLD. Ablesimov, V. E.; Bonyushkin, E. K.; Morovov, A. P. (Inst. of Atomic Energy, Moscow). pp 173-175 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565–P1.

The cross section for the ^{12}C(n,p)^{12}B reaction near threshold was measured. The neutrons were obtained from the T(d,n)^{4}He reaction. A cylindrical plastic scintillator 16 cm in diameter and 6 cm in length served as the carbon-containing target and permitted the counting of the ^{12}B decay beta rays. The cross section was found to be 1.2 ± 0.2 mb at 14.8 MeV and 0.8 ± 0.2 mb at 14.1 MeV. (auth)

3741 ELASTIC AND INELASTIC SCATTERING OF NEUTRONS WITH INCIDENT ENERGY OF 4.37 MeV. Popov, V. I.; Trykova, V. I. (Physical-Technical Inst., Moscow). pp 223-228 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565–P1.

Angular distributions of neutrons with initial energy 4.37 ± 0.18 MeV elastically and inelastically scattered by Li, B, Na, Cr, Ni, Sr, and Nb are given. A scintillation spectrometer with pulse shape discrimination of gamma rays was used. (2 figures, 2 tables) (auth)

3742 DEFORMATION PARAMETERS FOR LIGHT NUCLEI. Grin, Yu. T.; Kochetov, A. B. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 18: No. 2, 283-287(Aug 1973). (In Russian).

Parameters of quadrupole, hexadecapole and 2^6-pole deformation are calculated for the nuclei. The importance of these deformations in calculations and in treating experimental data is demonstrated. (auth)

3743 INVESTIGATION OF ABSORPTION OF STOPPED π^--MESONS BY OXYGEN NUCLEI WITH EMISSION ^{8}Li. Agababyan, N. M.; Batusov, Yu. A.; Bunyatov, S. A.; Genchev, V. I.; Golovanova, N. F.; Gulkanyan, G. R.; Sidorov, V. M.; Chernev, Kh.M.; Yarba, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 2, 264-269(Aug 1973). (In Russian).

Capture of stopped π^--mesons by oxygen nuclei with emission of Li^8 was studied by means of photoemulsion chambers. Branchings of the reaction are determined. For the reaction that is the most probable reaction among these with the ^{16}O target and with production of ^{8}Li, energy distributions of the secondary particles, effective mass and angular distributions for the (H^{2}p,n) system are presented. Theoretical analysis of this reaction is carried out. Comparison of theoretical calculations with the experimental data shows that in the reactions on carbon studied previously, the absorption mechanism is a capture of the π^--mesons by the four-nucleon cluster ^{4}Li. (auth)

3744 INVESTIGATION OF ABSORPTION OF STOPPED π^--MESONS BY NITROGEN NUCLEI WITH EMISSION OF ^{8}Li. Agababyan, N. M.; Batusov, Yu. A.; Bunyatov, S. A.; Genchev, V. I.; Golovanova, N. F.; Gulkanyan, G. R.; Sidorov, V. M.; Chernev, Kh. M.; Yarba, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 2, 256-263(Aug 1973). (In Russian).

Capture of stopped π^--mesons by nitrogen nuclei with emission of ^{8}Li was studied by means of photoemulsion chambers. Branching of the reaction channels is obtained. Energy, angular and effective mass distributions for combinations of the secondary particles are constructed for the reactions. Theoretical analysis in the framework of the theory of direct nuclear reactions was carried out using shell-model wave functions for the nuclear states. Comparing the theoretical calculations with the experimental data one concludes that a role of mechanisms of the pion capture by a pp-pair and by more complicated nucleon clusters ^{3}Li, ^{5}Li, ^{6}Be is essential for the absorption of stopped π^--mesons by nitrogen nuclei. (auth)

3745 REACTION ^{7}Li(γ,pt)^{3}H AT $E_\gamma \le 27$ MeV. Kotikov, E. A.; Makhnovskii, E. D. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 2, 245-249(Aug 1973). (In Russian).

The reaction ^{7}Li(γ,pt)^{3}H (Q = 22.28 MeV) was searched using the thick-layer photoplates loaded with the ^{7}Li isotope, in the γ-quanta energy range 23 to 27 MeV. To extract the reaction the momentum and energy conservation laws were used. The energy dependence of the cross section is obtained. The integral reaction cross section in the mentioned energy region is found to be (1.0 ± 0.1) MeV · mb. (auth)

3746 NUCLEAR ABSORPTION CROSS SECTIONS FOR PIONS, KAONS, PROTONS, AND ANTIPROTONS IN THE MOMENTUM RANGE 6 TO 60 GeV/c. Gorin, Yu. P.; Denisov, S. P.; Donskov, S. V.; Krasnokutskii, R. N.; Petrukhin, A. I.; Prokoshkin, Yu. D.; Stoyanova, D. A. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 18: No. 2, 336-347(Aug 1973). (In Russian).

Absorption cross sections for $\pi^\pm$, $K^\pm$, protons, and antiprotons on nuclei Li, Be, C, Al, Cu, Sn, Pb, and U are measured at the IHEP 70-GeV accelerator in the momentum range from 6.65 up to 60 GeV/c. The cross sections are compared with the calculations based on the Glauber multiple scattering model. The nuclear radii are determined having the power dependence on the atomic weight, $R = r_0A^{1/3}$, with $r_0 = 1.05 \pm 0.02$ f. (auth)

3747 ^{14}N(d,p)^{15}N REACTIONS IN THE DEUTERON ENERGY RANGE FROM 1 TO 3 MeV. Porto, V. (Univ., Sao Paulo, Brazil). Rev. Brasil. Fis.; 2: No. 2, 47-49(Aug 1972).

In general, the (d,p) and (d,n) reactions in the energy range from 1 to 3 MeV in light nuclei show a large contribution from the stripping mechanism and also pronounced structures in the excitation curves. The structures observed seem to be associated with the excitation of only a few particles in the compound nucleus. Some ideas concerning the ^{14}N(d,p$_4$)^{15}N (Ex = 7.16 MeV), ^{14}N(d,p$_5$)^{15}N (Ex = 7.31 MeV) and ^{14}N(d,p$_6$)^{15}N (Ex = 7.57 MeV) reactions mechanism are discussed, and a model is proposed to explain the broad structure (Γ ~ 650 keV) observed in the p$_5$ excitation curves. (auth)

3748 ROOT MEAN SQUARE RADIUS OF OPTICAL POTENTIAL IN π^-–^{12}C ELASTIC SCATTERING. Beiner, J.; Germond, J. F. (Univ. of Neuchatel, Switzerland). Phys. Lett.; 46B: No. 3, 289-290(1 Oct 1973).

The description of pion-nucleus elastic scattering by a local optical potential involves an energy-dependent radius. Fitted effective radii are compared with the prediction from the p-wave predominance assumption. (auth)

3749 SU(3) COUPLING FOR NEGATIVE-PARITY STATES OF ^{16}O. Mueller-Arnke, A. (Argonne National Lab., IL). Phys. Lett.; 46B: No. 3, 325-328(1 Oct 1973).

Results of a shell-model calculation for negative-parity T = 0 states of ^{16}O are reported. Comparison with earlier work on the problem of low-lying collective states suggests that the difficulty in getting these states low enough in energy is probably related to the strong truncations of the vector space. (auth)

3750 HIGH RESOLUTION TIME-OF-FLIGHT SYSTEM FOR PRECISE MEASUREMENT OF EXCITATION ENERGIES AND

Q-VALUES. Huenges, E.; Roesler, H.; Vonach, H. (Technische Univ., Munich). Phys. Lett.; 46B: No. 3, 361-363(1 Oct 1973).

A time-of-flight system was installed for the measurement of accelerator beam energies with an absolute accuracy of 1.5 : 10^5 as proved by determining excitation energies in ^{60}Ni. The first T = $^3/_2$ resonance in $^{12}C(p,p)^{12}C$ was measured at E_p = 14230.75 ± 0.20 keV. (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 38$

Refer also to abstracts 3348, 3679, 3717, 3718, 3720, 3721, 3741, 3742, 3746, 3779, 3781, 3784, 3791, 3794, 3815, 3821, 3832, 3882, 4006, 4045, 4090, and 4091.

3751 (COO-2176-20, pp 2-3) R-MATRIX FITTING OF NATURAL SODIUM. Rahn, F.; Slagowitz, M.; Havens, W. W. Jr.; Rainwater, J.; Singh, U. 1973.

In neutron spectroscopy. Progress report, July 1, 1972–June 30, 1973.

3752 (INP-837) INVESTIGATIONS OF THE STRUCTURE OF 1d–2s SHELL NUCLEI USING NUCLEAR REACTIONS. Wiktor, S. (Institute of Nuclear Physics, Krakow (Poland)). May 1973. 117p. (In Polish). Dep. NTIS (U. S. Sales Only) $8.00.

Investigations on the microscopic structure of some nuclei of the 1d–2s shell were performed. For this purpose the differential cross sections of a few proton groups from the reaction $^{32}S(d,p)^{33}S$ were measured. The spectroscopic factors derived from this experiment were then compared with the values predicted by the shell model with mixed configurations. A second experiment was done on the inelastic scattering of deuterons on the ^{39}K nucleus. Collective modes of excitation were found and the measured transition ratios analyzed in terms of the phonon-particle coupling theory. (auth)

3753 (JINR-D6-7094, pp 57-58) ENERGY DISTRIBUTION OF OF PHOTOPROTONS FROM THE ^{26}Mg NUCLEUS. Varlamov, V. V.; Ishkhanov, B. S.; Kapitonov, I. M.; Kocharova, Zh. L.; Piskarev, I. M.; Shevchenko, O. P. (Moscow State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3754 (JINR-D6-7094, pp 59-60) CROSS SECTION FOR PHOTOPROTON REACTIONS OF ^{26}Mg AND ^{27}Al. Varlamov, V. V.; Ishkhanov, B. S.; Kapitonov, I. M.; Piskarev, I. M.; Shevchenko, O. P. (Moscow State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3755 (JINR-D6-7094, pp 61-62) EXCITATION OF HIGH-LYING LEVELS OF ^{27}Al, ^{28}Si, AND ^{40}Ca DURING INELASTIC SCATTERING OF POLARIZED PROTONS. Plavko, A. V.; Tirion, Zh.; Gosse, Zh.; Kudryashov, V. I.; Lombar, R. M.; Maier, B. (Leningrad State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3756 (JINR-D6-7094, pp 63-64) WEAK-COUPLING METHOD FOR THE DESCRIPTION OF THE ROTATIONAL SPECTRUM OF THE DEFORMED NUCLEUS ^{29}Si. Vibike, Kh.; Myunkhov, L. (Central Inst. for Nuclear Research, Rossendorf, Ger.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3757 (JINR-D6-7094, pp 186-187) ENERGY SPECTRUM, PROBABILITY OF ELECTRIC QUADRUPOLE TRANSITIONS, AND ELECTRIC QUADRUPOLE MOMENT OF NUCLEI OF THE SD SHELL. Salakhitdinov, A. N.; Sharipov, Sh. (Inst. of Nuclear Physics, Tashkent). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3758 (JINR-D6-7094, p 190) EXCITED STATES OF EVEN–EVEN AND ODD–ODD NUCLEI OF THE SD SHELL. Karaev, R.; Salakhitdinov, A. N.; Sharipov, Sh. (Inst. of Nuclear Physics, Tashkent). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3759 (USNDC-7, pp 56-57; 64; 66-71) RESULTS FOR Cl. Singh, U. N.; Rainwater, J. (Columbia Univ., New York). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3760 INVESTIGATION OF THE REACTION $^{37}Cl(n,\gamma)^{38}Cl$. Spits, A. M.; Akkermans, J. A. (Reactor Centrum Nederland, Petten). Nucl. Phys.; A215: No. 2, 260-276(1973).

With Ge(Li) detectors the γ-radiation following thermal-neutron capture in natural and in ^{37}Cl enriched targets was studied. A total of 79 γ-lines was assigned to the $^{37}Cl(n,\gamma)$ reaction and 64 of these lines were placed in a decay scheme of ^{38}Cl. The excitation energies of 24 bound states of ^{38}Cl were determined with 0.09–1.2 keV errors. The neutron separation energy of ^{38}Cl is 6107.7 ± 0.4 keV. A strong correlation between reduced stripping widths and (n,γ) primary reduced widths was found for the $l_n(d,p) = 1$ states if, instead of the Weisskopf reduction factor E_γ^{-3}, a factor $E_\gamma^{-1.2}$ was used. (auth)

3761 ENERGY LEVELS OF A = 21 TO 44 NUCLEI (V). Endt, P. M.; Van Der Leun, C. (Fysisch Laboratorium Rijksuniversiteit, Utrecht). Nucl. Phys.; A214: 1-625(1973).

The experimentally determined properties of energy levels of A = 21 to 44 nuclei are compiled and evaluated with emphasis on nuclear spectroscopy. For each of the nuclides reviewed, the available information on excitation energies, spins, parities, isospins, lifetimes or widths and observed decay is summarized in a master table. (auth)

3762 LIFETIMES OF THE FIRST $^7/_2{}^-$ LEVELS IN ^{35}Cl AND ^{37}Cl. Brandolini, F.; De Poli, M.; Rossi Alvarez, C. (Univ., Padua). Lett. Nuovo Cim.; 8: No. 6, 342-344(6 Oct 1973).

The recoil distance method was used in the reactions of 11.2-MeV α particles with sulfur-32 and -34 to study lifetimes of the first $^7/_2{}^-$ levels in chlorine-35 and -37 respectively. Two typical spectra of the plunger measurement and the fraction of shifted-peak intensity to the total peak intensity in the recoil distance measurements as a function of the distance are shown. (JFP)

3763 DECAYS OF ^{26}Na and ^{27}Na. Alburger, D.E.; Goosman, D.R. (Brookhaven National Laboratory, Upton, New York 11973); Davids, C.N. Phys. Rev. C 8: No. 3, 1011-1017 (Sept 1973).

^{26}Na and ^{27}Na were produced in the $^{10}B(^{18}O, 2p)\,^{26}Na$ and $^{11}B(^{18}O, 2p)^{27}Na$ reactions by bombarding pellets of boron with 42-MeV ^{18}O ions. ^{26}Na was also studied using the $^{18}O(^{13}C, p\alpha)^{26}Na$ reaction at a ^{13}C beam energy of 35 MeV. After transfer of the target in a rabbit the β and γ rays were measured with NE102 and Ge(Li) detectors. ^{26}Na decays with $T_{1/2} = 1.087 \pm 0.012$ sec and emits 10 γ rays involving 7 excited states of ^{26}Mg. From the end-point energy of β rays in coincidence with 1809-keV γ rays the mass excess of ^{26}Na is found to be -7004 ± 200 keV in agreement with the more accurate data of reaction Q values. ^{27}Na decays with $T_{(1/2)} = 280 \pm 20$ msec in agreement with a previous measurement. γ rays of 984.77 ± 0.20 and 1698.5 ± 0.5 keV are emitted with relative intensities of 86.0 ± 2.9 and 14.0 ± 2.3, respectively. The spin of ^{27}Na is established as $J^\pi = (3/2)^+$ or $(5/2)^+$ from these data. From the end-point energy of ^{27}Na β rays in coincidence with 985-keV γ rays, compared with ^{26}Na β rays, the mass excess of ^{27}Na is -5650 ± 180 keV based on the ^{26}Na mass. This result is in fair agreement with a recent direct determination of the ^{27}Na mass. (auth)

3764 NEUTRON–GAMMA TIME-OF-FLIGHT STUDIES OF THE $^{29}Si(\alpha,n\gamma)^{32}S$ REACTION. Hancock, G. W. Jr. Charlottesville, VA; Univ. of Virginia (1973). 468p. University Microfilms Order No. 73-25,000.

Thesis (Ph. D.).

An associated-particle n-γ time-of-flight (TOF) spectrometer employing two NaI gamma detectors and n-γ pulse shape discrimination was used to study excited states in ^{32}S up to 6.76 MeV by means of the $^{29}Si(\alpha,n\gamma)^{32}S$ reaction. Utilizing a 50 to 150 nanoamp beam of $^4He^{++}$ ions from an unmodified 5.5 MV CN Van de Graaff, Litherland-Ferguson Method II particle–gamma angular correlation measurements were obtained from n-γ TOF spectra produced at bombarding energies of 8.5 and 10.24 MeV. More accurate kinematic identification of unknown TOF peaks was made possible by the development of a nonlinear least squares fitting program which determines an internally consistent set of TOF parameters based on identified TOF peaks in the spectrum. At 8.5 MeV, the TOF peaks corresponding to the ^{32}S levels at 2.23, 3.78, 4.46, and 5.01 MeV were analyzed; at 10.24 MeV, the 2.23, 5.01, 5.41, and 6.76 MeV levels were analyzed. A unique assignment of $J^\pi = 2^+$ was made for the 2.23 MeV level, and best fits for the 3.78 (0^+), 4.46 (4^+), 5.01 (3^-) and 5.41 (3^+) MeV levels were obtained for the accepted values of the spins and multipole mixing ratios. The spin of the 6.76 MeV level was limited to $2 \leq J \leq 5$, and its mode of gamma decay was confirmed to be 95 ± 5% to the 3^- level at 5.01 MeV by the analyses of: γ-ray spectra gated by the 6.76 MeV TOF peak, and TOF spectra gated by γ rays of different energies. The interpretation of these spectra was facilitated by the use of a digital data smoothing program which employs filtered Fourier transform techniques. The experimental results for the lower levels are consistent with the generally prevailing interpretation of ^{32}S as an anharmonic vibrator. The decay mode of the 6.76 MeV level, in conjunction with its recent J^{π} assignment of 5^- by other workers, lends support to its possible identification as the 5^- member of a $(1^-, 2^-, 3^-, 4^-, 5^-)$ quadrupole-octupole quintuplet expected in the vibrational collective model. The levels at 5.80 MeV (1^-), 6.22 MeV (2^-), and 6.62 MeV (4^-) have recently been tentatively associated with this multiplet by another group. The 6.67 MeV level is a possible candidate for the 3^- member; a determination of its spin, parity, and decay mode would be of interest. (Diss. Abstr. Int., B)

3765 DEVELOPMENT OF A METHOD FOR COMPLETE QUANTITATIVE SPECTROSCOPIC ANALYSIS OF LITHIUM-INDUCED ALPHA TRANSFER REACTIONS AND ITS APPLICATION TO $^{28}Si(^6Li,d)^{32}S$ AND $^{28}Si(^7Li,t)^{32}S$ REACTIONS. Al Jadir, M. N. I. Philadelphia; Univ. of Pennsylvania (1973). 146p. University Microfilms Order No. 73-24,110.

Thesis (Ph. D.).

The amplitudes of the four-nucleon shell model configurations of ^{32}S residual states formed by the $^{28}Si(^6Li,d)^{32}S$ and $^{28}Si(^7Li,t)^{32}S$ reactions were determined. This has necessitated the development of a method for complete quantitative spectroscopic analysis applicable to a wide scale of residual nuclei formed by lithium-induced alpha transfer reactions. The development of the method consists of the formulation of a general expression for the theoretical equivalent of the residual state spectroscopic factor P_{R_x}; the determination of the projectile normalization factors; the derivation of P_{R_x} for a residual state R_x; and, finally, estimation of the amplitudes of the configurations contributing to P_{R_x} by equating P_{R_x} with its theoretical expression. The reactions were induced by using charged particle beams from the University of Pennsylvania Tandem Accelerator. The outgoing particles were momentum-analyzed by the multiangle magnetic spectrograph. PWBA and DWBA calculations were used for the analysis of the angular distributions. The ^6Li and ^7Li normalization factors were determined to be 0.79 and 0.66 respectively, enabling the determination of P_{R_x} for the low lying natural parity states of ^{32}S. The theoretical expression of each P_{R_x} was facilitated by using $SU_6 \supset SU_3$ and $SU_3 \supset R_3$ coupling coefficients for the residual models and by formulating a general expression for determining the probability of the internal state of each of these residual models, i.e., the probability of the unspurious part of the general center-of-mass wave function for each of the $SU_6 \supset SU_3 \supset R_3$ models. The amplitude of the four-nucleon configuration of the first 2^+ state of ^{32}S was found to be considerably small, so that it is about one-fifth of that of the first 4^+ state, making it unlikely that these states are purely rotational, thus lending support to the vibrational description of the structure of the low lying states, as opposed to the coexistence model. Dynamical factors for various alpha transitions were assessed, and the change in the values of these dynamical factors as L_α varies within each of the $^{28}Si(^6Li,d)^{32}S$ and $^{28}Si(^7Li,t)^{32}S$ reactions was examined. A comparison was made between the dynamical factors of these reactions, as well as between the $^{28}Si(^6Li,d)^{32}S$ and $^{20}Ne(^6Li,d)^{24}Mg$ reactions. These comparisons were deliberately made to reveal the general characteristics of the kinematical parameters of alpha particle transitions of $(^6Li,d)$ and $(^7Li,t)$ reactions. (Diss. Abstr. Int., B)

3766 PROGRESS IN THE SD-SHELL. van der Leun, C. (Rijksuniversiteit, Utrecht). pp 1-19 of Fifth Symposium on the Structure of Low-Medium Mass Nuclei. Davidson, J. P. (ed.). Lexington, KY; University Press of Kentucky (1973).

From 5th symposium on the structure of low medium mass nuclei; Lexington, Kentucky, USA (26 Oct 1972). See CONF-721066-.

The discussion covers trends in nuclear spectroscopy, gamma-ray strengths and energies, and capture reactions. (JFP)

3767 HIGH-SPIN STATES IN ^{27}Al AND THE NUCLEAR STRUCTURE OF NUCLEI AROUND MASS 28. de Voigt, M. J. A. (Univ. of Rochester, NY). pp 51-55 of Fifth Symposium on the Structure of Low-Medium Mass Nuclei. Davidson, J. P. (ed.). Lexington, KY; University Press of Kentucky (1973).

From 5th symposium on the structure of low medium mass nuclei; Lexington, Kentucky, USA (26 Oct 1972). See CONF-721066-.

Levels in aluminum-27 were investigated using the $^{23}Na(\alpha,\gamma)$ reaction at 2.69 MeV. Angular correlation measurements uniquely determine the spin of the $E_\alpha = 2.69$ MeV resonance as $J = {}^{11}/_2$. The strong alignment for high-spin resonances in this reaction makes the angular distribution quite insensitive for the relative occupation of the magnetic substates. Study of four significant resonances combined with the results of additional Doppler shift lifetime measurements give several unique spin and parity assignments. The angular distributions are shown. (JFP)

3768 RESOLUTION OF ANGULAR CORRELATION AMBIGUITIES FOR HIGH SPIN STATES USING A 3 Ge(Li) DETECTOR COMPTON POLARIMETER. Sharpey-Schafer, J. F. (Univ. of Liverpool). pp 56-62 of Fifth Symposium on the Structure of Low-Medium Mass Nuclei. Davidson, J. P. (ed.). Lexington, KY; University Press of Kentucky (1973).

From 5th symposium on the structure of low medium mass nuclei; Lexington, Kentucky, USA (26 Oct 1972). See CONF-721066-.

The (α,n) reaction on the spin-zero targets ^{26}Mg, ^{30}Si, and ^{34}S was used to study the states of ^{29}S, ^{33}S, and ^{37}Ar. The gamma-ray linear polarization measurements can select a unique spin and mixing ratio for the states studied. Energy-level schemes are shown, and also a diagram showing the E2 strengths of negative-parity levels decaying to the ${}^7/_2{}^-$ level at 1611 keV in ^{37}Ar. (JFP)

3769 ROLE OF NUCLEAR COEXISTENCE IN SHELL MODEL SPECTRAL DIFFERENCE CALCULATIONS. Goode, P. (Rutgers-The State Univ., New Brunswick, NJ). pp 90-121 of Fifth Symposium on the Structure of Low-Medium Mass Nuclei. Davidson, J. P. (ed.). Lexington, KY; University Press of Kentucky (1973).

From 5th symposium on the structure of low medium mass nuclei; Lexington, Kentucky, USA (26 Oct 1972). See CONF-721066-.

The anomaly of the $^{38}Cl/^{40}K/^{40}K$ spectral difference calculations is investigated in the shell model. The interplay of the valence effective interaction and space truncation as well as some convergence properties of the valence effective interaction and its effective particle rank are illustrated. (JFP)

3770 BAND STRUCTURE OF ^{20}Ne. Alexander, T. K. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 272-300 of Fifth Symposium on the Structure of Low-Medium Mass Nuclei. Davidson, J. P. (ed.). Lexington, KY; University Press of Kentucky (1973).

From 5th symposium on the structure of low medium mass nuclei; Lexington, Kentucky, USA (26 Oct 1972). See CONF-721066-.

Some previous results are shown, and some new data giving information on the higher $K^{\pi} = 0^+$ bands in neon-20 and their mixing with the ground-state band are presented. (JFP)

3771 EXCITATION FUNCTIONS FOR THE REACTIONS $^{27}Al(n,p)^{27}Mg$ AND $^{27}Al(n,\alpha)^{24}Na$. Nemilov, Yu. A.; Trofimov, Yu. N. (Radium Inst., Moscow). pp 169-173 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

Excitation functions for the reactions $^{27}Al(n,p)^{27}Mg$ and $^{27}Al(n,\alpha)^{24}Na$ were measured by an activation method in the neutron energy range from 7.7 to 9.3 MeV. The $^2H(d,n)^3He$ reaction was used for obtaining monochromatic neutrons. (2 figures, 1 table) (auth)

3772 FORBIDDEN (p,t) EXCITATION OF UNNATURAL PARITY FINAL STATES FROM 0^+ TARGETS VIA MULTISTEP PROCESSES. Udagawa, T.; Olsen, D. K. (Univ. of Texas, Austin). Phys. Lett.; 46B: No. 3, 285-288(1 Oct 1973).

An estimate of the (p-d-t) successive single-neutron pickup cross section is shown to be in disagreement with experimental data for the "forbidden" $^{22}Ne(p,t)^{20}Ne(4.97\ MeV, 2^-)$ transition. Furthermore, it is shown that cross sections at very forward angles are important to distinguish whether a "forbidden" transition proceeds via inelastic excitations or successive single-neutron pickup. (auth)

3773 POSSIBLE BUBBLE NUCLEI-^{36}Ar AND ^{200}Hg. Campi, X.; Sprung, D. W. L. (McMaster Univ., Hamilton, Ont.). Phys. Lett.; 46B: No. 3, 291-295(1 Oct 1973).

The question of bubble configurations for ^{36}Ar and ^{200}Hg is studied by Hartree-Fock calculations using the density dependent force G-O. By imposing a constraint the solutions can be studied as a function of bubble deformation. Pairing is included in a self consistent manner via a B.C.S. calculation. Factors leading to bubble versus uniform distributions are discussed. (auth)

3774 GENERATOR COORDINATE METHOD APPLIED TO ^{20}Ne. Une, T. (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 49: No. 5, 1587-1601(May 1973).

An attempt is made to explain the low lying states of ^{20}Ne in the generator coordinate method. The intrinsic wave function is a simple Slater determinant of the Nilsson single-particle wave functions. The generator wave functions for the generator coordinate β (the parameter for Y_{20}-deformation) are determined in a new numerical method. Three lowest states for each total angular momentum are derived from the generator wave functions. Results are compared with those in the shell model and those in a coexistence model which mixes prolate and oblate deformations. (auth)

3775 SHELL EFFECTS IN ELASTIC SCATTERING OF NUCLEONS BY NUCLEI, AND NEUTRON STRENGTH FUNCTIONS. Adamchuk, Yu. V.; Zaretskii, D. F.; Sirotkin, V. K.; Urin, M. G. (Moscow Engineering-Physics Inst.). JETP Lett. (USSR) (Engl. Transl.); 17: No. 12, 473-475(20 Jun 1973).
Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 12, 683-687(20 Jun 1973).

The shell approach to the description of nucleon scattering by nuclei is used to parametrize the scattering matrix averaged over the resonances of the compound nucleus. Concrete calculations are performed for the s-neutron strength functions. It is shown that, in contradiction to the predictions of the optical model, the magnitude and the isotopic dependence of the strength function at the minimum (A ~ 100 to 140) are determined, in the main, by the spectroscopic factor of the 3s state. (auth)

3776 INNER BREMSSTRAHLUNG ACCOMPANYING THE ELECTRON CAPTURE IN ^{36}Cl. Smirnov, Yu. G.; Batkin, I. S. (Vorenezh State Univ., USSR). Yadern. Fiz.; 18: No. 2, 239-244 (Aug 1973). (In Russian).

The spectrum of the inner bremsstrahlung accompanying the doubly forbidden electron capture in nucleus ^{36}Cl was measured in the energy range from 600 up to 1040 keV by means of one-crystal scintillation spectrometer. The value of 1141 ± 8 keV was obtained for the transition energy in the experiment. The experimental value of the form factor of the inner bremsstrahlung spectrum is explained by the theory with account of indirect transitions. (auth)

Nuclear Properties and Reactions, $39 \leq A \leq 58$

Refer also to abstracts 3348, 3679, 3719, 3736, 3741, 3752, 3755, 3761, 3769, 3775, 3815, 3816, 3821, 3824, 3825, 3881, 3882, 3964, 3976, 4102, 4111, and 4367.

3777 (INIS-mf-339) STUDY OF THE INTERACTION OF SLOW NEUTRONS WITH POLYCRYSTALLINE IRON. Vinhas, A. L. (Universidade Estadual de Campinas (Brazil)). 1970. 121p. (In Portuguese). INIS.
Thesis.

Thermal neutrons are used to determine the total cross section of polycrystalline iron, in the range of 0.0028 to 0.11 eV. Measured scattering comprises magnetic scattering. A time-of-flight spectrometer discriminates the neutrons from the IEAR-1 reactor. (auth)

3778 (INP-823) MICROSCOPIC MODEL OF THE ELASTIC SCATTERING OF MEDIUM ENERGY ALPHA PARTICLES. Budzanowski, A.; Dudek, A.; Grotowski, K.; Majka, Z.; Strzalkowski, A. (Institute of Nuclear Physics, Krakow (Poland)). Nov 1972. 33p. Dep. NTIS (U. S. Sales Only) $3.75.

A microscopic description of the elastic scattering of medium energy alpha-particles is given in terms of an optical potential calculated from an effective nucleon–nucleon interaction and the nuclear matter distribution in both colliding nuclei. The model and its properties are studied for $45 \leq A \leq 208$ with the effective nucleon–nucleon interaction of Slanina–McManus form. Double folding procedure applied results in the form factor of the real potential different from the Saxon–Woods one. Good agreement with experimental data is obtained and the real potential depth of about 200 MeV predicted. (auth)

3779 (INP-838) INTERFERENCE MAXIMA IN THE BACKWARD EXCITATION CURVE IN α-PARTICLE ELASTIC SCATTERING ON MEDIUM-WEIGHT NUCLEI. Budzanowski, A.; Chyla, K.; Czabanski, R.; Grotowski, K.; Jarczyk, L.; Kamys, B.; Kapuscik, A.; Micek, S.; Ploskonka, J.; Strzalkowski, A.; Szmider, J.; Wrobel, Z.; Zastawniak, L.; Zybert, R. (Institute of Nuclear Physics, Krakow (Poland)). May 1973. 25p. Dep. NTIS (U. S. Sales Only) $3.25.

Excitation functions for the elastic scattering of α-particles from Ni, Co, and Cu at $\theta_{lab} = 179°$ were measured in the lab energy range 22.75 to 28.40 MeV as well as angular distributions for Co at some α-particle energies. In the excitation functions broad maxima with a width of about 2.5 MeV were found. It was shown that the simple four parameter optical model of the interaction is able to reproduce angular distributions as well as excitation functions. Examination of the Argand diagrams leads to the conclusion that the maxima in the excitation curves are formed as a result of a coherent superposition of some number of partial waves, none of which behaves in a resonance like manner. (auth)

3780 (JINR-D6-7094, pp 15-16) COLLECTIVE 0^+ STATES OF NUCLEI WITH A ~ 56. Dzholos, R. V.; Kartavenko, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3781 (JINR-D6-7094, pp 25-26) EXCITATION OF THE 0^+, 2^+, AND 3^- STATES IN LIGHT AND INTERMEDIATE NUCLEI BY INELASTIC SCATTERING OF POLARIZED PROTONS. Plavko, A. V. (Leningrad State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3782 (JINR-D6-7094, pp 65-66) BAND MIXING IN ^{43}Sc. May, F. R.; Muenchow, L. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3783 (USNDC-7, pp 197-199) MEASUREMENT OF DIFFERENTIAL ELASTIC AND INELASTIC CROSS SECTIONS FOR C, Al, Fe, Ni, Nb, AND In AT 12 MeV. Carlson, J. D.; Rapaport, J. (Ohio Univ., Athens). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3784 (USNDC-7, pp 259-263) (p,n) REACTION DATA: MICROSCOPIC ANALYSIS. Bentley, R. F.; Zafiratos, C. D. (Univ. of Colorado, Boulder). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3785 FINE STRUCTURE OF ANALOG STATES. Mitchell, G. E. (North Carolina State Univ., Raleigh). pp 163-191 of Fifth Symposium on the Structure of Low-Medium Mass Nuclei. Davidson, J. P. (ed.). Lexington, KY; University Press of Kentucky (1973).

From 5th symposium on the structure of low medium mass nuclei; Lexington, Kentucky, USA (26 Oct 1972). See CONF-721066-.

The history and philosophy of the study of the fine structure of analog states is set forth first. The author presents illustrative examples, with no pretense of being either complete or definitive. After a discussion of experimental apparatus and procedures, examples of elastic scattering data are given. Next, Coulomb energies, spectroscopic factors, and fine structure distributions are treated, and results for the (p,n), (p,γ), and (p,p′) reactions from analog states are presented. After dealing briefly with statistical considerations, the paper concludes with comments on projected high-resolution experiments. (16 figures) (RWR)

3786 EFFECTS OF CORE EXCITATIONS IN THE VIOLATION OF THE NUCLEAR PARTICLE–PARTICLE TO PARTICLE–HOLE TRANSFORMATION. Goode, P. (Univ. of Rochester, NY). Nucl. Phys.; A213: No. 3, 589-608(1973).

A core-excited shell model for the mass-40 region is developed to account for the discrepancies between particle-particle (pp) and particle-hole (ph) nuclear partners. Explicitly, second order perturbative-type calculations are incomplete when used in an attempt to simultaneously account for the spectral discrepancies between ^{40}K($\nu f_{7/2}$-$\pi d_{3/2}^{-1}$) and the Racah transform of ^{38}Cl($\nu f_{7/2}$-$\pi d_{3/2}$) and those between ^{48}Sc($\pi f_{7/2}$-$\nu f_{7/2}^{-1}$) and the Racah transform of ^{42}Sc($\pi f_{7/2}$-$\nu f_{7/2}$). However, an (fd) shell model, which includes core excitations (multi-particle, multi-hole states) from the $0d_{3/2}$ shell to the $0f_{7/2}$ shell, yields the cancellation of the second order perturbative-type results which is necessary for a satisfactory explanation for both sets of spectral discrepancies. The usefulness of the model in the investigation of the positioning of core excited states in ^{40}Ca (like 8p-8h) and in the generation of effective operators is also explored. (auth)

3787 THEORY OF OVERLAP FUNCTIONS. II. The Overlap Representation. Clement, C. F. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Nucl. Phys.; A213: 493-509(1973).

Nuclear densities and the expectation values of electromagnetic operators are expressed explicitly in terms of the single particle overlap functions defined previously. Using the previous sum rules some of the properties of this representation are discussed. In some cases values of nuclear electrical moments can be obtained directly from experimental data on proton pick-up and stripping reactions. As an illustration the quadrupole and hexadecapole moments of ^{51}V are obtained with a discussion of the errors and uncertainties of the method. The value Q = −0.033 ± 0.01 b is found a possibly more acurate value than that found by other methods. (auth)

3788 $^{48}Ca(^6Li, ^6He)^{48}Sc$ REACTION AT 34 MeV. Gaarde, C. (Univ. of Rochester, NY); Kammuri, T. Nucl. Phys.; A215: No. 2, 314-328(1973).

Angular distributions were measured in the range from 5° to 50° for the $^{48}Ca(^6Li, ^6He)^{48}Sc$ reaction at $E(^6Li)$ = 34 MeV in a magnetic spectrograph. A rather clean spectrum of ^6He particles was obtained by using a sonic spark counter as the position defining device together with three proportional counters in an anticoincidence set-up. A microscopic description of the reaction has been used to predict absolute cross sections for the unnatural parity states of the $(f_{7/2})^2$ multiplet. A calculation of the configuration mixing shows that the cross section to especially the 1^+ state is strongly dependent on such a mixing. A number of states with excitation energies above 2.5 MeV are excited with cross sections similar to the low lying states. Comparison with DWBA calculations puts limits on the spins of the final states. (auth)

3789 SELECTIVE POPULATION OF HIGHLY EXCITED STATES IN (α,p) REACTIONS. Magda, M. T. (Inst. for Atomic Physics, Bucharest); Lukas, I.; Nistor, M.; Chevarier, A.; Chevarier, N.; Demeyer, A.; Hollinger, G.; Tran Minh Duc. Lett. Nuovo Cim.; 8: No. 6, 396-400(6 Oct 1973).

Proton spectra from (α,p) reactions on iron-54, -56, -57, nickel-58, -61, and copper-63 were observed at different emission angles between 20 and 160°. Differential cross sections were found, and excited states in cobalt-57, -59, -60, copper-61, -64, and zinc-66 were studied. (JFP)

3790 ANGULAR-DISTRIBUTION STUDIES OF γ RAYS FROM THE $^{45}Sc(n, n'\gamma)$ REACTION. Rogers, V.C.; Hedengren, D.C. (Brigham Young University, Provo, Utah 84601); Beghian, L.E.; Clikeman, F.S. Phys. Rev. C 8: No. 3, 1158-1161 (Sept 1973).

Angular distributions of γ rays from the $^{45}Sc(n, n'\gamma)$ reaction have been measured at an incident neutron energy of 1.41 MeV. Analysis of the distributions yielded a spin assignment of $(11/2)^-$ for the 1238-keV level. The results support the collective-model description of this nucleus. (auth)

3791 ISOSPIN MIXING FROM THE EFFECTIVE NUCLEON INTERACTION. Bertsch, G.F.; Wildenthal, B.H. (Cyclotron Laboratory, Department of Physics, Michigan State University, East Lansing, Michigan 48823). Phys. Rev. C 8: No. 3, 1023-1028 (Sept 1973).

Effective interactions determined from closed-shell-plus-two-particle spectra have a charge dependence which predicts isospin mixing for more complicated nuclei. We infer the isospin mixing in A = 44, 46, 48, and 52 on the basis of the observed A = 42 spectra. Agreement with experimental data is reasonable in four out of six cases; the best example is ^{44}Sc, where we verify that the n-p effective residual interaction is stronger than the n-n interaction. We also compare predictions to experiment for isospin mixing in A = 20 and 24, based on the charge dependence seen in the A = 18 spectrum. (auth)

3792 NUCLEON-TRANSFER REACTIONS AND COULOMB DISPLACEMENT ENERGIES. Friedman, E. (The Racah Institute of Physics, The Hebrew University, Jerusalem, Israel). Phys. Rev. C 8: No. 3, 996-1001 (Sept 1973).

Differential cross sections for several nucleon-transfer reactions on ^{40}Ca, ^{42}Ca, and ^{48}Ca are analyzed in distorted-wave Born approximation. It is shown that the values of the root-mean-square radius of the $1f_{7/2}$ proton in ^{41}Sc and the $1f_{7/2}$ neutrons in ^{48}Ca are quite well determined. These values are in a reasonable agreement with theoretical results obtained from shell-model and Hartee-Fock calculations, but imply Coulomb displacement energies which differ from experimental results by about 0.6 MeV. It is concluded that the anomaly observed in nuclear matter radii, as derived from Coulomb displacement energies, is probably due to difficulties in calculating these energies. (auth)

3793 $^{44}Ca(d,\alpha)^{42}K$ REACTION AT 4.0 MeV. Lee, S. T. Blacksburg, VA; Virginia Polytechnic Inst. and State Univ. (1973). 60p. University Microfilms Order No. 73-23,433.

Thesis (Ph. D.).

Distorted-wave Born-approximation (DWBA) analysis of direct reactions has proven to be a very useful tool in understanding single- and two-particle transfer reactions and nuclear structure. The 4MV Van de Graaff accelerator at Virginia Polytechnic Institute and State University was used to check the feasibility of DWBA analysis on the (d,α) reaction at low bombarding energies for medium weight nuclei where compound nuclear contributions are expected to be present. An excitation function is measured on the $^{44}Ca(d,\alpha)^{42}K$ reaction with incident bombarding energy ranging from 3.3 to 4.0 MeV. The angular distributions obtained from this reaction at 4.0 MeV bombarding energy and with a range of angles from 40 to 160°, are presented for the five strongest levels of ^{42}K along with the DWBA fits. The satisfactory DWBA fits and the L transfers predicted thereby, indicate that this type of analysis might indeed be useful. One good indication is by no means conclusive and more work of this type is needed to substantiate the results found here. (Diss. Abstr. Int. B)

3794 CORRELATIONS AND ANTICORRELATIONS OF THE REDUCED TRANSITION PROBABILITIES IN (n,γ) AND (d,p) REACTIONS FOR NUCLEI WITH A ≤ 81. Barchuk, I. F.; Belykh, G. V.; Golyshkin, V. I.; Murzin, A. V.; Ogorodnik, A. F. (Inst. of Nuclear Studies, Kiev). pp 65-71 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The correlation coefficient data between the reduced probabilities (I_γ/E_γ^3) for E1 transitions from capture states in the lower p levels in thermal neutron capture reactions and spectroscopic factors $S(2T_f + 1)$ for the same levels from (d,p) reactions were calculated for even-even target-nuclei with 24 ≤ A ≤ 80. The possibility of the presence of different thermal neutron capture mechanisms is discussed by using the correlation coefficient values. (1 figure, 1 table) (auth)

3795 DIFFERENTIAL CROSS SECTIONS FOR THE REACTIONS (n,n') AND (n,2n) FOR THE NUCLEI Mn, Co, AND Bi. Sal'nikov, O. A.; Lovchikova, G. N.; Kotel'nikova, G. V.; Fetisov, N. I.; Trufanov, A. M. (Physical-Technical Inst., Moscow). pp 214-218 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The spectra and differential cross sections of the (n,2n) and (n,n') reactions on Mn, Co, and Bi nuclei were investigated by using the time-of-flight method. The nuclear temperatures and spectra of the final neutrons from the (n,2n) reactions were determined. (3 figures, 4 tables) (auth)

3796 TOTAL NEUTRON CROSS SECTIONS FOR ISOTOPES OF TITANIUM, CHROMIUM, AND COPPER. Dyumin, A. N.; Kaminker, D. M.; Popova, G. N.; Smolin, V. A. (Ioffe Inst. of Physics and Tech., Leningrad). pp 273-277 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The total neutron cross sections for the isotopes of Ti, Cr, and Cu are reported. The best fit for the optical model was obtained by assuming 0.4 fm for the neutron-proton radius difference. (1 figure) (auth)

3797 STUDY OF THE (n,n'γ) REACTION IN A LINEAR ELECTRON ACCELERATOR. Savin, M. V.; Paramonova, I. N.; Khokhlov, Yu. A.; Chirkin, V. A. (Inst. of Atomic Energy, Moscow). pp 282-289 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

A method to determine the energy dependence of cross sections for the production of gamma rays by the inelastic interaction of neutrons with nuclei is described for incident neutron energies up to 7 MeV in a linear electron accelerator. Neutron energy was determined by the time-of-flight method with a resolution of 1.25 ns/m. The gamma rays were detected with a NaI(Tl) crystal. Preliminary results for gamma rays (E_γ = 845 keV) from iron are given. (4 figures) (auth)

3798 MEASUREMENT OF THE PHOTONEUTRON SPECTRA FROM THE $^{56}Fe(\gamma,n)^{55}Fe$ REACTION NEAR THRESHOLD. Abramov, A. I.; Kitaev, V. Ya.; Staviesskii, Yu. Ya.; Yutkin, M. G. (Moscow State Univ.). pp 289-292 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

There are discussed some possibilities of using the results of photoneutron cross section measurements near threshold for refinement of the data on cross sections for the inverse radiative capture reaction, for the development of ideas on the mechanism of the gamma and neutron interaction with atomic nuclei, and for obtaining some information on the parameters of these processes.

The results of the first measurements of neutron spectra from the ^{56}Fe $(\gamma,n)^{55}$Fe reaction, performed by the time-of-flight method on the FEI microtron, are reported. (1 figure) (auth)

3799 TWO-PARTICLE, TWO-HOLE $J^\pi = 0^+$ STATES IN ^{40}Ca. Alford, W. P.; Lindgren, R. A.; Elmore, D.; Boyd, R. N. (Univ. of Rochester, NY). Phys. Lett., 46B: No. 3, 356-358 (1 Oct 1973).

Excited $J^\pi = 0^+$ states in ^{40}Ca were identified by the observation of L = 0 angular distributions in the ^{38}Ar$(\tau,n)^{40}$Ca reaction. Strong transitions are observed to the ground state, the known 2p–2h at 9.38 (T = 1) and 11.98 MeV (T = 2), and to states at 8.28 and 10.65 MeV. The strongest excited-state transition is to the 8.28 MeV state, which was identified as the 2p–2h T = 0 state. The $J^\pi = 0^+$ state at 7.30 MeV which was suggested as the 2p–2h T = 0 state is not observed. (auth)

3800 $(^{16}O,^{12}C)$ AND $(^6Li,d)$ AS α-TRANSFER REACTIONS. DeVries, R. M. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Rev. Lett.; 30: No. 14, 666-668(2 Apr 1973).

By means of a finite-range distorted-wave Born-approximation program which exactly includes recoil, α spectroscopic factors are extracted from the $(^6Li,d)$ and $(^{16}O,^{12}C)$ reactions on ^{40}Ca. The production of $^{12}C^*(2^+)$ is correctly predicted to be suppressed. The results are consistent with the assumption of an α-particle transfer as dominant in the two reactions. (auth)

3801 SCATTERING OF HIGH ENERGY PROTONS BY ^{58}Ni AND ^{208}Pb NUCLEI. Starodubskii, V. E. (Inst. of Nuclear Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 12, 470-473(20 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 12, 675-678(20 Jun 1973).

The theoretical calculations of the form factors and differential cross sections for 1-GeV proton elastic and inelastic scattering on nickel-58 and lead-208 are compared with data. (JFP)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 3720, 3741, 3746, 3775, 3778, 3779, 3781, 3784, 3789, 3794–3796, 3857, 3870, 3881, 3882, 3921, 3961, 3976, 4006, 4045, 4107, and 4111.

3802 (COO-2176-20, p 2) CROSS SECTION AND RESONANCE PARAMETERS FOR Cu. Rahn, F.; Makofske, W. 1973.

In neutron spectroscopy. Progress report, July 1, 1972–June 30, 1973.

3803 (JINR-D6-7094, pp 67-68) GAMMA DECAY OF ANALOG RESONANCES AND STATES IN ^{61}Cu. Kraft, O. E.; Lebedev, P. P.; Naumov, Yu. V.; Sizov, I. V. 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3804 (JINR-D6-7094, p 69) INVESTIGATION OF THE DECAY OF ^{77}Rb. Liptakh, Ya. (Joint Inst. for Nuclear Research, Dubna, USSR); Ortlepp, Kh. G.; Khabenikht, V.; Yakhim, M.; Arl't, R. 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3805 (JINR-D6-7094, p 70) ISOMERIC STATE IN ^{78}Rb. Zibert, Kh. U. (Joint Inst. for Nuclear Research, Dubna, USSR); Liptak, Ya.; Khabenikht, V.; Yakhim, M.; Arl't, R. 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3806 (JINR-D6-7094, p 71) DECAY OF ^{87}Nb. New Isotope ^{86}Nb. Votsilka, I.; Kratsik, B.; Liptak, Ya.; Novgorodov, A. F.; Toshev, M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3807 (JINR-D6-7094, p 72) DECAY OF ^{88g}Nb AND ^{88m}Nb. Bayar, B.; Votsilka, I.; Zaitseva, N. G.; Kratsik, B.; Liptak, Ya.; Novgorodov, A. F.; Ortlepp, Kh. G.; Toshev, M.; Khabenikht, V. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3808 (JINR-D6-7094, p 73) DECAY OF ^{89}Nb. Votsilka, I. (Joint Inst. for Nuclear Research, Dubna, USSR); Zibert, Kh. U.; Kratsik, B.; Liptak, Ya.; Novgorodov, A. F.; Khabenikht, V.; Toshev, M. 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3809 (RCN-191) CALCULATED NEUTRON ABSORPTION CROSS SECTIONS OF 75 FISSION PRODUCTS. Lautenbach, G. (Stichting Reactor Centrum Nederland, Petten (Netherlands)). Jul 1973. 62p. Dep. NTIS (U.S. Sales Only) $5.25.

The evaluation of this 26 group cross section set for 75 fission product isotopes was made in the framework of the STEK project. A large number of fission product isotopes is being measured in five different fast reactor neutron spectra. Apart from using existing evaluated cross section sets, it was considered necessary to make an evaluation, one of the main reasons being that only then it would be possible to make a simultaneous evaluation and calculation of the uncertainties in the group cross sections obtained. These uncertainties will be needed for the interpretation of the reactivity measurements performed in the STEK reactor cores. The methods used to evaluate the group cross section set (for 75 isotopes) are described and the results are given in the tables. This set will be referred to as the RCN-1 set. For most of the isotopes, the resonance parameters used in the calculations were updated until August 1971. In the near future a new evaluation of the neutron absorption cross section of fission product-isotopes will be made at RCN, then based on more detailed nuclear models. (auth)

3810 NUCLEAR LIFETIMES THROUGH THE USE OF THE CRYSTAL BLOCKING TECHNIQUE. Temmer, G. M. (Rutgers–The State Univ., New Brunswick, NJ). pp 192-214 of Fifth Symposium on the Structure of Low-Medium Mass Nuclei. Davidson, J. P. (ed.). Lexington, KY; University Press of Kentucky (1973).

From 5th symposium on the structure of low medium mass nuclei; Lexington, Kentucky, USA (26 Oct 1972). See CONF-721066-.

A description is first given of the crystal blocking lifetime technique, which deals with the suppression, along crystalline axes and planes, of nuclear reaction yields of secondary charged particles from nuclei situated at lattice sites. Crystal blocking lifetime experiments are then reviewed. First generation experiments discussed are 1) delay in fission, 2) delay in inelastic proton scattering, and 3) reaction delay from a single compound-nucleus reaction. Second generation experiments discussed are 1) enhancement of compound-nucleus fine structure near analog resonances, 2) residual-state spin effect on average compound-nucleus lifetime, 3) residual-state structure effect on average compound-nuclear lifetime. Results are given for inelastic proton scattering on germanium. Some experiments which seem within the realm of experimental possibility in the not-too-distant future are discussed: 1) distinction of compound and shape elastic scattering by time delay and 2) lifetimes in $(p,\bar{n}p)$ and $(d,\bar{n}p)$ reactions. An example of a possible lifetime measurement of an elementary particle, the η^0, is also given. (LBS)

3811 MIXING RATIOS IN ^{67}Zn DETERMINED BY GAMMA–GAMMA ANGULAR CORRELATIONS. Bargholtz, C.; Eriksson, L.; Gidefeldt, L. (Univ. of Stockholm). Z. Phys.; 263: No. 2, 89-97(1973).

The gamma–gamma angular correlations of the 209.0–184.6, 494.3–393.6, 464.3–300.2 and 703.6–184.6 keV cascades in ^{67}Zn have been measured. Mixing ratios of the 209.0, 300.2, 393.6 and 703.6 keV transitions are deduced. A spectroscopic study could not confirm the existence of a recently proposed level at 710 keV. (1 figure, 2 tables) (auth)

3812 ANALYSIS OF INELASTIC COLLISIONS OF PARTICLES WITH NUCLEI AT VERY HIGH ENERGIES. Barashenkov, V. S.; Eliseev, S. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol.; B4: No. 5, 601-606(1973).

The experimental data on pion- and nucleon-nucleus interaction at energies considerably higher than 10 GeV are analysed on the basis of the intra-nuclear cascade model including a decrease in the number of intra-nuclear nucleons during the cascade development. Experiment and theory can be fitted at energies up to $T \approx 100$ GeV within experimental accuracy. At higher energies the calculated multiplicity of shower particles noticeably exceeds the experimental values. The effects of many-particle interactions are discussed from this point of view. (auth)

3813 EMISSION OF FAST LITHIUM FRAGMENTS IN INTERACTIONS OF 25 GeV/c PROTONS WITH Ag AND Br NUCLEI. Sieminska, J.; Soltynski, K. (Inst. of Nuclear Research, Warsaw). Acta Phys. Pol.; B4: No. 5, 639-646(1973).

Production of ^{6}Li and ^{7}Li fragments with $E \gtrsim 10$ MeV/nucleon in the interactions of 25 GeV/c protons with heavy emulsion nuclei was investigated. In particular, the influence of the fast fragment on the emission of the heavy product was analysed. (auth)

3814 REACTION MECHANISMS INVOLVED IN THE FORMATION OF ^{24}Na FROM ^{75}As AT HIGH PROTON BOMBARDING ENERGIES. Urbon, J. A. Pittsburgh; Carnegie-Mellon Univ. (1973). 172p. University Microfilms Order No. 73-18,330.
Thesis (Ph. D.).

^{75}As(p,x)^{24}Na reaction yields at energies from 100 MeV to 400 MeV have been shown previously to differ from expected spallation predictions. To ascertain whether this deviation persisted at higher bombarding energies, cross-section measurements were made at 550 MeV, 3, 6, and 11.5 GeV. This data, coupled with the 100 MeV to 400 MeV cross sections, was used to construct an ^{75}As-^{24}Na excitation function. Comparisons were made with Rudstam's empirical equation which describes the ^{24}Na excitation function behavior in terms of a spallation mechanism, and with Silberberg's and Tsao's fragmentation-spallation formula which incorporates both a spallation and a fission or fission-like contribution to the functional form of the theoretical excitation function. In addition to the integral cross-sections, differential cross-section angular distribution measurements on the ^{75}As-^{24}Na system were conducted at 550 MeV and 11.5 GeV, for varying target thicknesses, to provide further data on the ^{24}Na formation mechanism(s). The 550 MeV experimental results were then compared with a variety of theoretical calculations, based on the Serber model, in which the first step of the proton induced reaction was simulated by the VEGAS-STEPNO Monte Carlo computer code, and the de-excitation step was simulated by (1) the EVAP Monte Carlo evaporation code (spallation residue calculations), (2) a high temperature fission program followed by further de-excitation with the EVAP code, and (3) a composite calculation using the results from (1) and (2). After comparisons between the theoretical and the experimental angular distributions were made, it was concluded that none of the simple two-step mechanisms, spallation and high temperature fission, could satisfactorily reporduce the experimental results, but that the combined spallation plus high-temperature fission mechanism could adequately account for the production of ^{24}Na from ^{75}As with high energy protons. In the absence of ^{24}Na recoil kinetic energy data, no conclusion could be made on the applicability of a fast, one-step fragmentation mechanism. (LBS)

3815 COMPLETE HYDROGEN AND HELIUM PARTICLE SPECTRA FROM 30- TO 60-MeV PROTON BOMBARDMENT OF NUCLEI WITH A = 12 TO 209 AND COMPARISON WITH THE INTRANUCLEAR CASCADE MODEL. Bertrand, F.E.; Peelle, R.W. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 8: No. 3, 1045-1064 (Sept 1973).

Differential cross sections for the production of proton, deuteron, triton, helium–3, and α particles from as many as 10 targets (A = 12–209) were measured using 29–, 39–, and 62–MeV incident protons. The particles were detected, with ≈0.2–MeV [full width at half maximum (FWHM)] energy resolution for protons, over a secondary energy range of ≈ 2 – 62 MeV in a total absorption telescope composed of three solid–state detectors. Representative results are shown for cross sections differential in energy and angle, as well as for angle- and energy–integrated cross sections. For incident 60–MeV protons the integral magnitude of the nonevaporation charged–particle production is found to be $\approx 10^2 A^{1/3}$ mb. Fewer protons but more complex particles were measured for carbon and oxygen targets than expected from an $A^{1/3}$ dependence for either component alone. The continuum cross sections for z = 1 particles at a given angle (mb sr^{-1} MeV^{-1}) are nearly independent of incident energy when measured with incident protons in the 30– to 60–MeV energy range. Nonevaporation production of complex particles ($A \geq 2$) is 25–40% of that for protons. The proton spectra have been compared with predictions from the intranuclear cascade model. Differential spectral predictions compare well with the measured spectra for angles in the range ≈ 25–60°, and relatively poor predictions for small and large angles are more favorable when reflection and refraction by the potential well are included. Evidence is given that predictions for backward angles are greatly improved by allowing proton scattering from nucleon pairs within the model nucleus, but the A–dependent underprediction at extreme forward angles is not understood at all. The calculated angle–integrated spectra reproduce the measured spectral shape but consistently predict ≈30% too few nonevaporation protons for targets with $A \geq 27$. (auth)

3816 THRESHOLD PHOTONEUTRON CROSS SECTION FOR ^{60}Ni and ^{56}Fe. Verbinski, V.V.: Weber, H.; Sund, R.E. (Intelcom Rad Tech, San Diego, California 92138). Phys. Rev. C 8: No. 3, 1002-1010 (Sept 1973).

The absolute differential cross sections of ^{60}Ni(γ,n) and Fe(γ,n) were measured near the thresholds for ^{60}Ni and ^{56}Fe using time–of–flight techniques to determine the neutron energies. The measurements were taken at 93° to the incident bremsstrahlung beam. Two measurements were made for each target, each with a different bremsstrahlung–beam end–point–energy setting, in order to determine the specific levels to which the neutrons decay. The absolute bremsstrahlung spectra were determined from neutron time–of–flight calibration measurements that utilized the known ^{2}H(γ,n) reaction cross section. The ^{60}Ni(γ,n) data show numerous peaks in the neutron energy region up to 75 keV; of these, five definitely decay to the ^{59}Ni ground state. The Fe(γ,n) data had strong peaks at neutron energies of 2.1 and 10.0 keV in the laboratory system; the results indicate that the 2.1–keV peak decays to the 0.411–MeV state in ^{55}Fe and that the 10.0–keV peak decays to the ^{55}Fe ground state. Resonance parameters for ^{60}Ni and ^{56}Fe states are given for the observed strong isolated peaks. The experimentally determined γ–ray strength functions are consistent with the single–particle estimate of the electric dipole γ–ray strength function. (auth)

3817 PROTON PICKUP FROM ^{86}Sr AND THE ^{85}Rb LEVEL STRUCTURE. Ragaini, R.C. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550); Knight, J.D.; Leland, W.T. Phys. Rev. C 8: No. 3, 988-995 (Sept 1973).

The levels of ^{85}Rb have been investigated by the ^{86}Sr(t, α) reaction with 15–MeV tritons. α–particle spectra were measured by a ΔE–E counter telescope system with an over–all resolution of 50 keV. Angular distributions were measured from 12.5 to 90°, and comparison with distorted–wave Born–approximation calculations permitted angular–momentum assignments for 11 of the 20 levels observed. The data are compared with previous information on the ^{85}Rb level structure. (auth)

3818 DECAYS OF ^{72}Kr AND ^{73}Kr. Davids, C.N. (Center for Nuclear Studies, University of Texas at Austin, Texas 78712); Goosman, D.R. Phys. Rev. C 8: No. 3, 1029-1034 (Sept 1973).

Delayed γ rays following the decay of two new proton–rich Kr isotopes have been observed. These isotopes were produced by the bombardment of ^{58}Ni with ^{16}O ions, and were separated from contaminant activities by a gas–transfer system. ^{72}Kr decays with a half–life of 17.4 ± 0.4 sec to states in ^{72}Br, with the subsequent emission of six γ rays. ^{73}Kr decays with a half–life of 25.9 ± 0.6 sec to states in ^{73}Br, and emits eight γ rays. Identification of the Kr isotopes was based both on the buildup of their daughters, and on relative intensities of decay γ rays observed at two different ^{16}O bombarding energies. Decay schemes are presented, and the astrophysical significance of ^{72}Kr is discussed. (auth)

3819 NATURE OF EXCITED STATES OF NUCLEI ^{69}Zn, ^{71}Ge, ^{77,79,81}Se PRODUCED IN CAPTURE OF THERMAL NEUTRONS. Murzin, A. V.; Kolomiets, V. M. (Inst. of Nuclear Research, Kiev). Yadern, Fiz.; 18: No. 3, 479-484(Sep 1973). (In Russian).

Properties of the de-excitation of the capture state in the nuclei ^{69}Zn, ^{71}Ge, ^{77,79,81}Se produced by the thermal neutron capture are considered. Presence of simple configurations like the doorway states in these nuclei near the bound energy results in enhancement of the E1 transitions from the capture state to lower levels of a similar nature. (auth)

3820 EXCITATION OF GIANT QUADRUPOLE RESONANCE IN ^{60}Ni BY MEANS OF ELECTRON SCATTERING. Gul'karov, I. S. (Tashkent Polytechnic Inst.). Yadern. Fiz.; 18: No. 3, 519-523(Sep 1973). (In Russian).

Resonances at 13.0 ± 0.3, 16.3 ± 0.2 and ~28.5 MeV are detected in the excitation region of the nucleus ^{60}Ni from 10 up to 30 MeV. The form factors for the resonances 13.0 and 16.3 MeV are obtained and it is shown that the first of them is a quadrupole (E2) resonance, and the second one is the well known giant dipole (E1) resonance. The characteristics of these resonances, the reduced transition probabilities, the radiation widths and the enhancement factors are presented and compared with the similar results obtained by other authors for nuclei ^{90}Zr and ^{208}Pb. The measured form factors are compared with predictions of the dynamical collective model by Danos and Greiner. (auth)

3821 YADERNYI GAMMA-REZONANS I ATOMNYE STOLKNOVENIYA. (Nuclear Gamma-Resonance and Atomic Collisions). Kaipov, D. K.; Kosyak, Yu. G. Alma-Ata, USSR; Izdatel'stvo Nauka Kazakhskoi SSR (1973). 136p.

The following aspects of nuclear gamma-resonance scattering are considered; the effect of source state on yield of gamma-resonance scattering (GRS), compensating recoil energy losses during GRS on nuclei, effect of the state of the gamma source on yield of GRS, theory of GRS, microspectrum of the gamma rays as a result of recoil from a previous emission, microspectrum of gamma rays and limits of applicability from a model of continuous collisions, GRS experimental technique with condensed sources, effect of radiation on the state of the source, GRS with liquid sources, effective interaction radii, interaction potentials, GRS with metallic sources, GRS scattering of 1330 keV gamma quanta from Co-60 (half-life of 10,47 min) on Ni-60, slowdown of recoil nuclei (Cr-52) in a vanadium source, GRS at the 1780 keV level of Si-28, GRS of 1594 keV gamma quanta of La-140 in Ce-140 nuclei, determining the slowing down of recoil atoms in rubidium metal by GRS, GRS of 1293 and 1370 keV gamma quanta from the decay of Na-24 and In-116 in Sn-116 and Mg-24 nuclei, slowing down distance of recoil atoms as a function of the internuclear distance in metals, and GRS with sources in the form of various compounds. The book contains 18 tables, 66 illustrations, and 146 references. (SJR)

3822 MEASUREMENT OF THE NEUTRON CAPTURE CROSS SECTION IN GALLIUM. Bergman, A. A.; Romanov, S. A.; Samsonov, A. E. (Lebedev Inst. of Physics, Moscow). pp 149-150 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The neutron capture cross section for gallium was measured in energy region 0.2 eV to 70 keV. (1 figure) (auth)

3823 TOTAL α WIDTHS OF NEUTRON RESONANCES. Popov, Yu. P.; Pshitula, M.; Rumi, R. F.; Semenov, V. G.; Stempin'ski, M.; Florek, M.; Furman, V. I. (Joint Inst. for Nuclear Research, Dubna USSR). pp 151-155 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The results of the search for the (n,α) reaction on the target nuclei of ^{64}Zn, ^{67}Zn, and ^{177}Hf are reported. These data and the earlier measured values of the average $\langle\Gamma_\alpha\rangle$ widths (or upper estimates) for ten isotopes in the mass under region $95 \leq A \leq 189$ are compared with the results of the calculations from the nuclear optical model. The fluctuations of total α widths are analyzed, and the possibility of spin identification of resonances by the values of total α widths is indicated. The distribution of Γ_α widths and the results of the resonance spin identification for the ^{147}Sm nucleus from recent measurements with a neutron energy resolution of 40 ns/m are presented. (4 figures) (auth)

3824 STUDY OF THE POLARIZATION IN ELASTIC SCATTERING OF NEUTRONS WITH 1.5 MeV ENERGY BY MEDIUM-MASS NUCLEI. Korzh, I. A.; Kostyuk, T. A.; Mishchenko, V. A.; Pasechnik, M. V.; Pravdivyi, N. M.; Sanzhur, I. E. (Inst. for Nuclear Research, Kiev). pp 262-266 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

Measurements of the polarizing power of nuclei with $46 < A < 122$ for the elastic scattering of 1.5-MeV neutrons in the angular range 20 to 145° are presented. The experimental data on the angular distributions and polarizing power of the nuclei studied are analyzed in terms of the nuclear optical model. (2 figures, 1 table) (auth)

3825 ANALYSIS OF DATA ON THE SCATTERING OF NEUTRONS WITH 2.9 MeV ENERGY BY ISOTOPES OF NICKEL. Pasechnik, M. V.; Fedorov, M. B.; Yakovenko, T. I. (Inst. for Nuclear Research, Kiev). pp 277-282 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The differential cross sections for the elastic and inelastic scattering of 2.9-MeV neutrons by ^{58}Ni, ^{60}Ni, and ^{62}Ni were measured by the time-of-flight method. The experimental angular distributions of elastically scattered neutrons were analyzed on the basis of the optical model. The angular distributions of inelastically scattered neutrons were compared with statistical theory calculations. The best agreement for ^{58}Ni corresponds to a small value of the compound-nucleus moment of inertia $(G = 0.3G_{\text{rigid body}})$. (2 figures, 2 tables) (auth)

3826 PHOTO-PROTONS FROM HEAVY ELEMENTS. Dougan, P.; Kivikas, T.; Lugner, K.; Ramsay, V.; Stiefler, W. (Univ. of Lund, Sweden). Phys. Lett., 46B: No. 3, 359-360 (1 Oct 1973).

Preliminary values of the cross sections for the emission of high energy photo-protons from targets of copper, silver and gold irradiated with 400-MeV bremsstrahlung are reported. (auth)

3827 CORIOLIS COUPLING IN SOME INTERMEDIATE NUCLEI. Delepanque, M. A. (Institut de Physique Nucleaire, Orsay, France); Gerschel, C.; Perrin, N.; Quentin, P. Phys. Lett., 46B: No. 3, 317-321(1 Oct 1973).

Coriolis coupling calculations are performed for high/unique parity orbitals where this coupling is expected to counterbalance strong coupling between the odd particle and the core. An accurate description of the even-even core rotational states is introduced. In the $1g_{9/2}$ and $1h_{11/2}$ proton, $1h_{11/2}$ and $1i_{13/2}$ neutron regions, some experimental levels of four typical nuclei which remained unexplained, are very satisfactorily reproduced. (auth)

3828 DECAY OF ^{83g}Se AND ^{83m}Se. Fettweis, P.; Sadasivan, S. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Z. Phys.; 263: No. 2, 99-120(1973).

The decay of the isomeric pair ^{83g}Se ($T_{1/2} = 22.6$ min, $I\pi = 9/2^+$) and ^{83m}Se ($T_{1/2} = 70$ s, $I\pi = 1/2^-$) was re-investigated using straight Ge(Li) and Ge(Li)-Ge(Li) coincidence spectrometry. Both decays populate entirely different ^{83}Br levels, 11 of them being previously unreported. From γ-ray unbalances and from the known isomeric cross section ratio of ^{82}Se, β^--branchings were obtained, including a 34% branching of ^{83m}Se to the ground state of ^{83}Br. Log ft-values are deduced, spin and parity values proposed and discussed. (orig.) (GE)

3829 LIFETIMES AND MAGNETIC MOMENTS OF TWO STATES IN ^{62}Cu. Bleck, J.; Butt, R.; Lindenberger, K. H.; Ribbe, W.; Zeitz, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Z. Phys.; 263: No. 2, 169-178(1973).

The lifetimes and the magnetic moments of the two excited ^{62}Cu states at 40.84 and 390.19 keV are investigated by time differential perturbed angular distribution measurements of the delayed γ-rays following the nuclear reactions $^{61}Ni(d,n)$ and $^{62}Ni(p,n)$. The results are: $\tau = 6.7 \pm 0.5$ nsec, $\mu = 1.32 \pm 0.03$ n.m. for the 2^+ state at 40.84 keV, and $\tau = 16.0 \pm 0.3$ nsec, $\mu = 2.00 \pm 0.01$ n.m. for the 3^+ state at 390.19 keV. (GE)

3830 ELECTRON SCATTERING ON $^{66,68}Zn$ NUCLEI. Litvinenko, A. S.; Shevchenko, N. G.; Afanas'ev, N. G.; Afanas'ev, V. D.; Buki, A. Yu.; Likhachev, V. P.; Polishchuk, V. N.; Savitskii, G. A.; Khvastunov, V. M.; Khomich, A. A.; Chkalov, I. I. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 18: No. 2, 250-255(Aug 1973). (In Russian).

Cross sections are measured for elastic and inelastic electron scattering on the ^{68}Zn nucleus at the initial electron energy of 225.0 ± 0.2 MeV, and for the elastic scattering on ^{66}Zn. Differences in parameters of the Fermi charge distributions for these nuclei are determined. Analysis of the electron scattering cross section indicates an effect of the neutron subshell filling on the charge density shape in the nucleus. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 2704, 2756, 2800, 3190, 3679–3682, 3741, 3746, 3775, 3778, 3781, 3784, 3809, 3812, 3813, 3815, 3821, 3824, 3826, 3827, 3894, 3921, 3926, 3937, 3969, 4006, 4045, 4054, 4102, and 4107.

3831 (CEA-R-4499) DECAY OF ^{139}Cs. Monnand, E.; Blachot, J.; Brissot, R.; Carraz, L. C.; Crancon, J.; Ristori, C.; Schussler, F.; Moussa, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Sep 1973. 27p. (In French). Dep. NTIS (U.S. Sales Only) $3.50.

A study was made of the β and γ spectra following the decay of ^{139}Cs. The activity is produced on-line with the ARIEL isotope separator. The Q_β is 4.23 ± 0.1 MeV, the relative intensity of the ground state feeding β branch is (89.5 ± 1) per cent. A tentative level scheme is deduced from the results of Ge(Li) singles and Ge(Li)–Ge(Li) coincidence measurements, and is compared with earlier studies. (auth)

3832 (COO-2186-14) NUCLEAR SPECTROSCOPY AND NUCLEAR REACTION WORK WITH (A) THE HEAVY ION ACCELERATOR, YALE UNIVERSITY AND (B) THE 4 MeV DYNAMITRON AT SUNY, ALBANY, NEW YORK. Technical Progress Report, December 1, 1972–July 31, 1973. Bakhru, H. (State Univ. of New York, Stony Brook (USA)). Aug 1973. Contract AT(11-1)-2186. 32p. Dep. NTIS $3.75.

The studies of decay properties of several short lived neutron deficient isotopes were conducted using the Heavy Ion Accelerator at Yale. These studies are chosen to complement the in-beam studies, furnishing energy-level data on the same nuclei. The life-time studies on the excited states of several nuclei were completed. Studies on millisecond isomers of Pb, Os and Ir are being conducted. The measurement of the K-shell ionization with fully stripped projectile using various heavy ions have been carried out. The 4 MeV Dynamitron at SUNY/ALBANY was extensively used for the α-radiative capture studies on ^{26}Mg, ^{28}Si, ^{31}P, ^{35}Cl and ^{37}Cl. (auth)

3833 (JINR-D6-7094, pp 13-14) STRUCTURE OF LOW-LYING STATES IN EVEN–EVEN SPHERICAL NUCLEI WITH NEUTRON NUMBER N = 82. Vdovin, A. I.; Stoyanov, Ch. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3834 (JINR-D6-7094, p 74) DECAY OF ^{93}Tc. Anton'eva, N. M.; Barkov, A. V.; Zolotavin, A. V.; Zarubin, P. P.; Makarov, V. M.; Padalko, V. Yu.; Podkopaev, Yu. N. (Leningrad State Univ.). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3835 (JINR-D6-7094, pp 75-76) DECAYS ^{95}Zr → ^{95}Nb AND ^{95}Nb → ^{95}Mo. Anton'eva, N. M.; Barkov, A. V.; Zolotavin, A. V.; Makarov, V. M.; Sergeev, V. O. (Leningrad State Univ.). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3836 (JINR-D6-7094, pp 77-78) CASCADE GAMMA TRANSITIONS IN THE NUCLEUS ^{96}Mo. Anton'eva, N. M.; Barkov, A. V.; Zolotavin, A. V.; Kondrat, E. T.; Podkopaev, Yu. N.; Fominykh, V. I. (Leningrad State Univ.). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3837 (JINR-D6-7094, pp 79-80) DECAY OF ^{99}Rh. Anton'eva, N. M.; Barkov, A. V.; Zolotavin, A. V.; Katykhin, G. S.; Kondrat, E. T.; Fominykh, V. I.; Shablinskii, A. G. 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3838 (JINR-D6-7094, pp 81-82) ISOMERIC THREE-QUASIPARTICLE STATE IN ^{105}Cd. Heiser, C.; Brinckmann, H. F.; Fromm, W. D.; Hagemann, U.; Rotter, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). 1973.
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3839 (JINR-D6-7094, pp 83-84) NEW ISOMERIC STATE IN ^{107}Cd. Hagemann, U.; Brinckmann, H. F.; Fromm, W. D.; Heiser, C.; Rotter, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). 1973.
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3840 (JINR-D6-7094, pp 85-86) STUDY OF THE CONVERSION RADIATION OF THE E3 TRANSITIONS IN ^{107,109}Ag. Shevelev, G. A.; Troitskaya, A. G.; Kartashov, V. M. (Inst. of Nuclear Physics, Alma-Ata, USSR). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3841 (JINR-D6-7094, p 87) DETERMINATION OF THE INTENSITY OF THE β^- DECAY ^{117g}Cd → ^{117m}In. Sergienko, V. A.; Zarubin, P. P.; Vorontsovskii, A. V.; Padalko, V. Yu. (Leningrad State Univ.). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3842 (JINR-D6-7094, p 88) DETERMINATION OF THE COMPARATIVE YIELDS OF ^{117m}Cd AND ^{117g}Cd IN THE (d,p) REACTION. Sergienko, V. A.; Zarubin, P. P.; Padalko, V. Yu.; Vorontsovskii, A. V. (Leningrad State Univ.). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3843 (JINR-D6-7094, pp 89-90) INVESTIGATION OF THE DECAY OF ^{117m}Cd. Sergienko, V. A.; Zarubin, P. P.; Padalko, V. Yu.; Vorontsovskii, A. V.; Bibichev, B. A. (Leningrad State Univ.). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3844 (JINR-D6-7094, p 91) GAMMA SPECTRUM DURING THE DECAY OF ^{123}Ba. Arl't, R.; Gopych, P. M.; Noibert, V.; Ortlepp, Kh. G.; Yasinski, A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3845 (JINR-D6-7094, pp 92-93) EXCITED STATES OF ^{124}Cs AND ^{124}Xe FROM THE DECAY ^{124}Ba → ^{124}Cs → ^{124}Xe. Arl't, R.; Baier, G.; Gopych, P. M.; Zibert, Kh. U.; Ortlepp, Kh. G.; Tyrroff, Kh.; Kherrmann, E.; Yasinski, A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3846 (JINR-D6-7094, pp 94-95) STUDY OF GAMMA RAYS IN THE DECAY OF ^{125}Ba. Arl't, R.; Baier, G.; Gopych, P. M.; Noibert, V.; Ortlepp, Kh. G.; Yasinski, A.; Yakhim, M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3847 (JINR-D6-7094, pp 96-97) GAMMA EMISSION DURING THE DECAY ^{126}Ba → ^{126}Cs → ^{126}Xe AND THE LEVEL SCHEME OF ^{126}Cs. Arl't, R.; Baier, G.; Gopych, P. M.; Novgorodov, A. F.; Ortlepp, Kh. G.; Tyrroff, Kh.; Kherrmann, E.; Yasinski, A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3848 (JINR-D6-7094, pp 98-99) INVESTIGATION OF THE DECAY SCHEME OF ^{127}Ba. Arl't, R.; Baier, G.; Ortlepp, Kh. G.; Tyrroff, Kh.; Kherrmann, E.; Khaupt, Kh.; Yasinski, A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3849 (JINR-D6-7094, pp 100-101) STUDY OF ATOMIC MASS DIFFERENCES. Measurement of the β^+ Spectra Accompanying the Decay of ^{126}Ba and ^{128}Ba. Gonusek, M. (Joint Inst. for Nuclear Research, Dubna, USSR); Gopych, P. M.; Karakhodzhaev, A.; Novgorodov, A. F.; Finger, M.; Yasinski, A.; Yakhim, M. 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3850 (JINR-D6-7094, pp 102-103) MULTIPLET SPLITTING IN THE N = 81 NUCLEI ^{142}Pm AND ^{144}Eu. Funke, L. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Fromm, W. D.; Keller, H. J.; Arlt, R.; Gopytsch, P. 1973.
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3851 (JINR-D6-7094, p 104) MEASUREMENT OF THE g FACTOR OF THE 11/2$^-$ EXCITED STATE OF THE ^{149}Eu NUCLEUS BY THE METHOD OF DIFFERENTIAL ANGULAR CORRELATION IN AN EXTERNAL MAGNETIC FIELD AT A TEMPERATURE OF 1000°K. Klimentovskaya, M. V.; Lebedev, N. A.; Sorokin, A. A. (Moscow State Univ.). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3852 (JINR-D6-7094, pp 182-183) MEASUREMENT OF THE LIFETIME OF THE EXCITED STATES OF NUCLEI BY THE DOPPLER-SHIFT ATTENUATION METHOD FOR THE ENERGY OF γ QUANTA EMITTED AS A RESULT OF COULOMB EXCITATION. Erokhina, K. I.; Lemberg, I. Kh.; Pasternak, A. A. (Ioffe Inst. of Physics and Tech., Leningrad). 1973. (In Russian).
From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3853 (JINR-P6-7173) PROPERTIES OF THE LEVELS OF ^{138}Pr AND ^{138}Ce. Buttsev, V. S.; Vylov, Ts.; Kalinnikov, V. G.; Tikhonov, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 15p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.
The γ and the electron conversion spectra of ^{138}Nd and ^{138m,g}Pr were studied. The multipole orders of a series of γ transitions were established. $I^\pi = 0^+$ or 2^+, 0^+ or 2^+, 1^+, and 1^+ were assigned to the 194.2, 199.5, 326.9, and 541.1-keV levels of ^{138}Pr, respectively. It was proposed to interpret these states as due to the vibration state of the even–even nucleus in the one-frequency state of the unpaired nucleon. A series of new states in ^{138}Ce were reported. (tr-auth)

3854 (USIP-73-5) GAMMA–GAMMA DIRECTIONAL CORRELATIONS IN ^{119}Sb. Stefansson, V.; Eriksson, L.; Fransson, K. (Stockholm Univ. (Sweden). Fysiska Institutionen). Mar 1973. 12p. Dep. NTIS (U.S. Sales Only) $3.00.
Gamma–gamma directional correlations in ^{119}Sb were measured in the decay of ^{119m}Te. The directional correlation coefficients A_2 and A_4 were determined for the following cascades (energies in keV): 153-1213, 912-1366, 942-270, (976 + 979)-270, 1096-270, 1137-270, 2013-270, and 2089-270. The mixing ratios evaluated

are: $-0.009 \le \delta$ (M2/E1, 153 keV) ≤ 0.004, $-1.2 \le \delta$ (E2/M1, 270 keV) ≤ -0.070, $-1.2 \le \delta$ (E2/M1, 942 keV) ≤ -0.17, $-0.07 \le \delta$ (E3/M2, 1096 keV) ≤ 0.45 and $-0.025 \le \delta$ (E2/M1 or M2/E1, 2089 keV) ≤ 0.055 or $6.5 \le \delta$ (E2/M1 or M2/E1, 2089 keV) ≤ 14. The results are compared with theoretical predictions. (auth)

3855 (USIP-73-7) LEVELS AND TRANSITIONS IN ^{136}Ba. Bargholtz, C.; Eriksson, L.; Gidefeldt, L.; Holmberg, L.; Stefansson, V. (Stockholm Univ. (Sweden). Fysiska Institutionen). Mar 1973. 13p. Dep. NTIS (U.S. Sales Only) $3.00.

Excited states of ^{136}Ba are studied in the beta decay of ^{136}Cs. The gamma spectrum is measured with high resolution and coincidence techniques. Several new transitions are suggested to be connected with two recently reported levels. Gamma–gamma directional correlations are performed in an attempt to determine the characteristics of these levels, and in order to determine mixing ratios. The lifetime of the 2207.5 keV state is remeasured, and the lifetime of the 2140.5 keV state is measured for the first time. (auth)

3856 (USIP-73-13) LEVEL SCHEME OF ^{126}Te STUDIED BY GAMMA SPECTROSCOPY AND GAMMA–GAMMA ANGULAR CORRELATIONS. Bargholtz, C.; Becker, J.; Beshai, S.; Eriksson, L.; Fransson, K.; Gidefeldt, L.; Holmberg, L.; Stefansson, V. (Stockholm Univ. (Sweden). Fysiska Institutionen). Sep 1973. 26p. Dep. NTIS (U.S. Sales Only) $3.50.

The decay of ^{126}Sb to ^{126}Te is studied by use of Ge(Li) detectors in single and coincidence arrangements. The gamma–gamma directional correlations of six cascades are measured. A level scheme is constructed where all transitions observed are located. The characteristics of several of the levels are assigned, on basis of the log ft values deduced and the directional correlation results. Mixing ratios are deduced for three transitions. From the comparison of the relative intensities of E1 and E2 transitions depopulating the same levels, three E1 transitions are found to be strongly retarded. (auth)

3857 (USNDC-7, pp 1-4) INTEGRAL CROSS SECTION MEASUREMENTS IN THE CFRMF. Harker, Y. D. (Aerojet Nuclear Co., Idaho Falls, ID). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3858 (USNDC-7, pp 18-20) VALENCE COMPONENT IN ^{91}Zr(γ,n)^{90}Zr. Toohey, R. E.; Jackson, H. E. (Argonne National Lab., IL). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3859 (USNDC-7, pp 25-28) TRANSITION STRENGTHS IN Ba-135(n,γ)Ba-136. Holm, J. L.; Chrien, R. E.; Cole, G. W. (Brookhaven National Lab., Upton, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3860 (USNDC-7, pp 27; 29-32) VALIDITY OF THE VALENCE MODEL IN Mo-98. Cole, G. W.; Chrien, R. E.; Byrd, R. C.; Harvey, J. A.; Slaughter, G. G. (Brookhaven National Lab., Upton, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3861 (USNDC-7, pp 33-35) RESONANCE NEUTRON CAPTURE IN Ru. Rimawi, K.; Chrien, R. E.; Cole, G. W.; Wasson, O. A. (Brookhaven National Lab., Upton, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3862 PULSED BEAM DIRECT TIMING LIFETIME MEASUREMENTS USING Ge(Li) DETECTORS. Robertson, B. C. (Queen's Univ., Kingston, Ont.). pp 225-230 of Fifth Symposium on the Structure of Low-Medium Mass Nuclei. Davidson, J. P. (ed.). Lexington, KY; University Press of Kentucky (1973).

From 5th symposium on the structure of low medium mass nuclei; Lexington, Kentucky, USA (26 Oct 1972). See CONF-721066-.

The direct timing technique and some of its problems are briefly described. Use of the amplitude and rise-time compensation technique can reduce the residual time walk to about 1 ns/MeV; the procedure for measuring this walk under running conditions, where several prompt γ rays are present, is discussed. A typical time spectrum is shown. It is concluded that, by using a Ge(Li) detector to obtain good energy background suppression and a pulsed beam for good time background suppression and by using the pulsed beam to measure on-line the time behavior of both photopeak and background in the Ge(Li) detector, it should be possible to obtain reliable lifetime measurements in the ps range through the direct timing technique. (4 figures) (RWR)

3863 NEW M2 ISOMERS IN NEUTRON DEFICIENT I, La AND Pr ASSOCIATED WITH A DEFORMED NUCLEAR SHAPE. Conlon, T. W. (United Kingdom Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Phys.; A213: No. 3, 445-460(1973).

New isomeric states with half-lives of 144 μs, 170 μs and 105μs were observed in ^{115}I or ^{117}I, ^{131}La and ^{135}Pr respectively. In all three cases the isomeric transition is shown to have M2 multipolarity and probably connects states of spin $^{11}/_{2}{}^{-}$ and $^{7}/_{2}{}^{+}$ which are possibly the states $[505]^{11}/_{2}{}^{-}$ and $[413]^{7}/_{2}{}^{+}$ associated with deformed nuclear shape although the sign of the deformation is not determined. (auth)

3864 (t,α) REACTION ON EVEN TELLURIUM NUCLEI. Conjeaud, M. (CEN de Saclay, Gif-Sur-Yvette, France); Harar, S.; Caballero, M.; Cindro, N. Nucl. Phys.; A215: No. 2, 383-396(1973).

The (t,α) reactions on even tellurium isotopes (A = 122 to 130) were studied at an incident triton energy of 12 MeV. Alpha angular distributions of transitions leading to states of antimony nuclei were compared to DWBA calculations. Angular momentum transfers and spectroscopic factors were obtained. Present results show significant configuration mixing of the proton wave function in the tellurium targets. Proton hole states in Sb isotopes were located and the two-particle-one-hole interaction is discussed. (auth)

3865 PERTURBED ANGULAR CORRELATIONS. Matthias, E. (Freie Univ., Berlin). pp 1-7 of Hyperfine Interactions Detected by Nuclear Radiation. Liege; Univ. Liege (1973).

From hyperfine interactions detected by nuclear radiation; Liege, Belgium (11 Sep 1973).

Subject of PAC is the measurement of the perturbation factor $G^{qq}_{\lambda\lambda}(\omega t)$. It contains the interaction frequency from which the information about moment and field can be derived. Depending on the lifetime of the oriented state we can use different techniques to measure the perturbation factor. Accordingly this paper will be divided into three sections: I. time-integral PAC, range 10^{-12} sec $< \tau_N < 10^{-9}$ sec; II. time-differential and stroboscopic observation, range 10^{-9} sec $< \tau_N < 10^{-3}$ sec; III. NMR-techniques, range $\tau_N > 10^{-6}$ sec. (BE)

3866 ^{115}In(p,α)^{112}Cd REACTION AT PROTON ENERGY 14 MeV. Turkiewicz, I. M. (Inst. of Nuclear Research, Warsaw). Acta Phys. Pol.; B4: No. 5, 615-619(1973).

Energy spectra of α particles from the reaction ^{115}In(p,α)^{112}Cd were measured at proton energy $E_p = 14$ MeV. A discussion of experimental results in the frame of current nuclear reaction models is given. (auth)

3867 NEUTRON ACTIVATION CROSS SECTIONS IN RARE EARTHS AND HEAVIER NUCLEI. Siddappa, K.; Sriramachandra Murty, M.; Rama Rao, J. (Andhra Univ., Waltair, India). Nuovo Cim.; 18A: No. 1, 48-54(1 Nov 1973).

Radiative neutron capture cross sections for the isotopes ^{138}Ba, ^{140}Ce, ^{142}Ce, ^{146}Nd, ^{148}Nd, ^{160}Gd, ^{165}Ho, ^{180}Hf, ^{181}Ta, ^{190}Os, ^{197}Au and ^{202}Hg were measured at the neutron energy (23 ± 5) keV by means of the activation method and 4π-geometry gamma-counting technique. In 9 cases for each of which there is a single previous report of the cross-section, the present work serves as a check on the previous value. In the remaining cases the present study helps to resolve the existing discrepancies in the reported values. The present results are generally supported by the recent semi-empirical estimates of the cross section by Musgrove. (auth)

3868 CORRELATION BETWEEN TRANSVERSE AND LONGITUDINAL MOMENTA OF PHOTONS PRODUCED IN 9 GeV NEGATIVE PION INTERACTION WITH XENON NUCLEI. Siemiarczuk, T. (Univ., Warsaw). Acta Phys. Pol.; B4: No. 5, 621-624(1973).

Photon production in π^--Xe interaction at 9 GeV is analysed from the point of view of the description suggested previously. A strong correlation between transverse and longitudinal momenta of photons is observed similar to that in π^--nucleon interactions. (auth)

3869 NUCLEAR MAGNETIC RESONANCE ON ORIENTED ^{101}Rh^{m}. Kaindl, G.; Bacon, F.; Mahnke, H.; Shirley, D.A. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. C 8: No. 3, 1074-1079 (Sept 1973).

The 4.3-day isomer of ^{101}Rh was oriented in nickel metal by the thermal equilibrium nuclear orientation technique at temperatures down to 3 mK. From an analysis of the temperature dependence of the anisotropies of the 306.8- and 544.8-keV γ rays of ^{101}Ru, the E2/M1 mixing ratios of these two γ transitions, δ (306.8) = $-$ 0.10 $\pm$ 0.05 and δ (544.8) = $-$ 0.98 $\pm$ 0.10, as well as the magnetic hyperfine interaction of Ni(^{101}Rh^{m}), $|\mu H| = (6.2 \pm 0.2) \times 10^{-18}$ erg, could be derived. In addition, the previously assigned spins of the respective nuclear states of ^{101}Ru at 306.8 and 544.8 keV were both confirmed as 7/2. Nuclear magnetic resonance on oriented Ni(^{101}Rh) was observed in an external polarizing field of 1 kOe at a resonance frequency of 206.2 ± 0.4 MHz, yielding a magnetic hyperfine splitting of $|\mu H/I| = (1.366 \pm 0.003) \times 10^{-18}$ erg. As a result both the spin and the magnetic moment of ^{101}Rh^m could be determined as $I = 9/2$ and $\mu\ (9/2) = (+)(5.51 \pm 0.09)\mu_N$, corresponding to a nuclear g factor of $g(9/2) = 1.22 \pm 0.02$. The results confirm the interpretation of ^{101}Rh^m as a $1g_{9/2}$ proton state. The derived value of the g factor is compared with g factors of other $g_{9/2}$ proton states in the neighborhood of the magic proton number 40, and it is found to fit well into the over-all systematics. (auth)

3870 NUCLEON TRANSFER WITH OXYGEN IONS BELOW AND NEAR THE COULOMB BARRIER. Nair, K.G.; Blair, J.S.; Reisdorf, W.; Wharton, W.R.; Braithwaite, W.J.; Mehta, M.K. (Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. C 8: No. 3, 1129-1143 (Sept 1973).

Excitation functions have been measured at $\theta_{lab} = 170°$ for the reactions ^{140}Ce(^{16}O,^{15}N)^{141}Pr (E_{lab} = 56.0 to 63.0 MeV), ^{88}Sr(^{16}O,^{15}N)^{89}Y (42.5 to 50.0 MeV), and ^{140}Ce(^{18}O,^{17}O)^{141}Ce (56.0 to 61.0 MeV) proceeding to low excited states. Analysis has been made using the sub–Coulomb distorted–wave Born–approximation theory of Buttle and Goldfarb with inclusion of Coulomb correction terms in the form factor and the Buttle–Goldfarb approximation for recoil corrections. Good fits are obtained to the excitation functions at the lower energies. Normalization at these energies determines an essentially invariant quantity, namely the joint probability for the transferred nucleon being at radius R_1 with respect to the first core nucleus and radius R_2 with respect to the second, where $R_1 \equiv a[A_1^{1/3}/(A_1^{1/3} + A_2^{1/3})]$ and $R_2 \equiv a[A_2^{1/3}/(A_1^{1/3} + A_2^{1/3})]$, a being the distance of closest approach in a head–on collision averaged between incident and final channels. If specific assumptions are made for the geometrical parameters of the bound states, values can be extracted for the product of spectroscopic factors, $S^{(1)}\ S^{(2)}$; reasonable geometries lead to values of $S^{(2)}$ very close to those previously obtained from light–ion reactions. Above the barrier, the fits to calculations which use nuclear distorted waves are less satisfactory; for optical potentials which give nearly equivalent elastic scattering, the calculations show moderate ambiguity. We believe the leading uncertainty in our analysis is due to the approximate treatment of recoil. (auth)

3871 NEEDS FOR NUCLEAR DATA IN RADIONUCLIDE METROLOGY. Grinberg, B. (Laboratoire de Metrologie des Rayonnements Ionisants, Saclay, France). Nucl. Instrum. Methods; 112: No. 1-2, 19-22(1973).

The following points are underlined and discussed: (1) There is an evident need for evaluated decay scheme parameters given with their uncertainties. Neither the existing compilations, although some are very good, nor the quick evaluations available are able to fulfill this requirement. (2) The evaluation of published data requires an enormous effort. Such evaluations can obtain a general "consensus" only if they are made according to objective and universally admitted rules. These rules should allow: (a) to choose among published values those which are to be taken into consideration and those which are to be rejected. This implies to adopt well defined selection criteria; (b) the determination of uncertainties of the figures taken into consideration so as to enable calculation of the best value, which is the weighted mean of the above-mentioned figures. This precisely has been the aim of the Euratom evaluation group. The various rules which it has adopted have resulted from the systematic and thorough study of the decay schemes parameters of the following nuclides: ^{65}Zn, ^{58}Co, ^{60}Co, ^{51}Cr, ^{90}Sr. These rules are given. (3) In numerous cases, the uncertainties of the figures determined according to the above-mentioned rules are not satisfactory; they do not meet the users' requirements. If such is the case, new experimental determinations of the considered parameters are needed. (auth)

3872 ENERGY LEVELS IN ^{94}Zr FROM THE DECAY OF ^{94}Y. Singh, H.; Tikku, V. K.; Sethi, B.; Mukherjee, S. K. (Saha Inst. of Nuclear Physics, Calcutta). Radiochem. Radioanal. Lett.; 15: No. 3, 201-211(20 Oct 1973).

The decay of ^{94}Y to excited levels in ^{94}Zr was studied by means of Ge(Li) and scintillation spectrometers. The ^{94}Y sources were produced by the irradiation of enriched ^{94}Zr (92.8%), as well as spectroscopically pure Zr targets, with 14.7-MeV neutrons. The measurement of the half-life of ^{94}Y gave an average value of T = 19.7 ± 0.5 min. Six β groups with endpoint energies of 4.90 ± 0.10, 3.94 ± 0.10, 3.24 ± 0.20, 2.84 ± 0.15, 2.08 ± 0.30, and 1.14 ± 0.30 MeV are being reported for the first time. The γ rays found to decay with the above half-life are 387.7 ± 0.8, 551.5 ± 3.0, 588.3 ± 1.5, 753.1 ± 1.0, 920.4 ± 0.4, 1139.2 ± 0.7, 1447.8 ± 1.6, 1672.3 ± 0.8, 1847.0 ± 1.0, 1897.8 ± 1.0, 2147.9 ± 1.0, 2224.1 ± 1.0, 2518.3 ± 1.6, and 2839.2 ± 1.6 keV. A consistent decay scheme of ^{94}Y based on the results of the singles, $\gamma-\gamma$, and $\beta-\gamma$ coincidence experiments is proposed. The g.s. of ^{94}Y is assigned a spin–parity of 2^-. The cross section for the reaction ^{94}Zr(n,p)^{94}Y at 14.7 MeV neutron energy was measured as 8.9 ± 1.9 mb. (4 figures, 4 tables) (auth)

3873 DECAY OF ^{111m}Cd. Pathak, B. P.; Mukherjee, S. K. (Saha Inst. of Nuclear Physics, Calcutta). Radiochem. Radioanal. Lett.; 15: No. 3, 187-191(20 Oct 1973).

The decay of ^{111m}Cd was reinvestigated by using a Ge(Li) spectrometer. Gamma rays of (150.6 ± 0.2) and 245.8 ± 0.2) keV were observed to decay with a 49 min half-life and, hence, are assigned to ^{111m}Cd. The relative intensities of these γ rays were determined as (32.2 ± 1.5) and 100, respectively. By using these relative intensities and the reported value of the total internal conversion coefficient of the 245.8-keV transition, the total internal conversion coefficient of the 150.6-keV transition was determined to be 2.30 ± 0.16. (2 figures, 1 table) (auth)

3874 SEARCH FOR A QUADRUPOLE MIXING IN THE HYPERFINE INTERACTION OF Nd IONS RECOILING INTO VACUUM. Spehl, H.; Steadman, S. G.; Weckherlin, A.; Doubt, H. A.; Hagemeyer, K.; Kumbartzki, G. J.; Speidel, K. H. (Univ., Freiburg, i. B.). (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft on atomic and molecular physics; Munich, Germany (2 Apr 1973).

Time-differential perturbed angular correlations of gamma radiation have been measured for the 2^+-0^+ transitions in ^{146}Nd, ^{148}Nd and ^{150}Nd nuclei recoiling into vacuum. The 2^+ states were populated by Coulomb excitation with ^{16}O ions from a tandem accelerator. The recoil velocity was v/c = 1.3%. Due to the strong variation of the quadrupole moment of the 2^+ state from ^{146}Nd to ^{150}Nd the effect of a possible quadrupole interaction could be determined. The experimental results are compared with the predictions from different stochastic models. (6 figures) (tr-auth)

3875 ORIENTED TARGETS AND POLARIZED NEUTRONS IN NEUTRON PHYSICS. Alfimenkov, V. P. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 99-108 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565–P1.

The experiments which have been performed and some possible experiments using polarized slow neutrons and oriented nuclear targets are considered on the basis of published papers. In particular, the measurements of spin components of the cross section for the interaction of slow neutrons with nuclei, spin identification of neutron resonances, and determination of the magnetic and electric moments of nuclear excited states are treated. (auth)

3876 INVESTIGATION OF NEUTRON WIDTHS AND ORBITAL MOMENTUM FOR LEVELS OF ^{121}Sb AND ^{123}Sb BY INCIDENT NEUTRON. Adamchuk, Yu. V.; Muradyan, G. V.; Shchepkin, Yu. G. (Inst. of Atomic Energy, Moscow). pp 128-131 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565–P1.

The results of identification of s and p levels of separated antimony isotopes were obtained by the moving sample method. Measurements of total neutron cross sections, capture, and self-indication in the energy range up to ~1.5 keV were performed. The level parameters were determined; S_0 and S_1 strength function values were calculated. (1 figure) (auth)

3877 NEUTRON RESONANCES OF ^{112}Cd. Shchepkin, Yu. G.; Muradyan, G. V.; Adamchuk, Yu. V. (Inst. of Atomic Energy, Moscow). pp 132-135 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565–P1.

The results of identification of s and p levels by the moving sample method are presented. The measurements were performed on the linear electron accelerator of the Atomic Energy Institute with a resolution of 12 ns/m (total neutron cross section, capture, and self-indication). The level parameters in the incident-neutron energy range up to 4 keV were determined; S_0 and S_1 strength function values were calculated. (RWR)

3878 NEUTRON RESONANCES OF THE ISOTOPES ^{147}Sm AND ^{149}Sm. Karzhavina, E. N.; Popov, A. B. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 135-139 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565–P1.

The measurements of the transmission and yield of γ-rays from neutron capture for samarium samples with different isotopic composition were carried out on the neutron spectrometer of the Laboratory of Neutron Physics (JINR) with a resolution of 6 ns/m. The isotopic identification and parametrization of ^{147}Sm and ^{149}Sm resonances were performed in the regions up to 400 eV and 250 eV, respectively. The values of the average level spacings D for ^{147}Sm and ^{149}Sm [(7.2 + 0.9) eV; (2.3 + 0.3) eV] and the S_0-strength functions [(3.7 ± 0.8) × 10^{-4} and (5.1 ± 0.9) × 10^{-4}] were obtained. (auth)

3879 DISTRIBUTION OF THE PARTIAL α WIDTHS OF NEUTRON RESONANCES. Vil'gel'm, I.; Popov, Yu. P.; Pshitula, M.; Rumi, R. F.; Stempin'ski, M.; Frontas'eva, M. V. (Joint Inst. for Nuclear Research, Dubna USSR). pp 155-159 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

An analysis of the experimental values of partial α widths for neutron resonances of ^{147}Sm and ^{143}Nd is presented. Partial α widths for the transition to the ground state of the daughter nucleus obey the χ-square distribution with the number of degrees of freedom equal to unity; this is in agreement with the Porter–Thomas statistical assumptions regarding the reactions proceeding through the compound nucleus. The distribution of α-widths of transitions to the first excited states for the target nucleus ^{147}Sm turned out to be narrower. This is associated with the α-decay mechanism. (auth)

3880 DEVIATION FROM THE STATISTICAL DISTRIBUTION IN THE POSITION OF NEUTRON LEVELS IN MEDIUM AND HEAVY NUCLEI. Borovlev, S. P.; Sukhoruchkin, S. I. (Inst. of Theoretical and Experimental Physics, Moscow). pp 206-214 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

Correlation analysis was carried out by means of a computer for relative spacings between neutron levels of isotopes of antimony, silver, gold, radium, uranium, thorium, plutonium and some other nuclei measured with a high energy resolution. The results of the analysis are compared with a statistical model, with the results of the Ideno and Ohkubo analysis and also with deviations from statistical distributions (uv hyperfine structure in positions of excited levels of heavy nuclei). (4 figures, 1 table) (auth)

3881 INTEGRATED CROSS SECTION OF THE (n,2n) REACTION FOR ELEMENTS AT A NEUTRON ENERGY OF 14 MeV. Bed'i, Z.; Chikai, I. (Lajos Kossuth Univ., Debrecen, Hungary). pp 232-235 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

An (n,2n) cross section systematics was developed containing experimental data and using the N – Z dependence of these cross sections. After having calculated the (partial) data the $(\sigma_{n,2n})_Z$ values for elements were obtained from averaging over isotopic abundances. The $(\sigma_{n,2n})_Z$ cross sections are given with brief discussions. (2 figures, 1 table) (auth)

3882 DEPENDENCE OF THE TOTAL CROSS SECTION ON NEUTRON ENERGY AND ATOMIC NUMBER. Angeli, I.; Chikai, I. (Lajos Kossuth Univ., Debrecen, Hungary). pp 236-239 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The mass number dependence of total neutron cross sections was investigated. For light nuclei, it was found that a definite correlation exists between the nuclear radius parameter, r_0, and the binding energy per nucleon, ϵ, namely, $r_0\epsilon \approx 11$ MeV · fm. For medium and heavy nuclei, a simple empirical expression can be given to describe the dependence of cross section on mass number. It is shown that this expression can be well interpreted by the nuclear Ramsauer effect with a reasonable value of the real optical potential depth and a finite surface thickness. (3 figures) (auth)

3883 USE OF THE PSEUDORANDOM PULSE METHOD IN PULSED SOURCES FOR STUDY OF NEUTRON CROSS SECTIONS. Muradyan, G. V.; Pevzner, M. I. (Inst. of Atomic Energy, Moscow). pp 215-231 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The possibility of the application of the pseudo-random pulse method combined with the conventional pulse method is analyzed. It is shown that, for such experiments as S and P level identification by the moving sample method, measurement spectra of capture of γ rays, (n,α) reactions, resonance capture cross sections, and measurement of cross sections with a high uncorrelated background, the transition to the complex method is equal to the source quality increase. The application of the pseudo-random method on the linear electron accelerator and on the linear proton accelerator is considered. (5 figures) (auth)

3884 DEVICE FOR MEASUREMENT OF THE ENERGY DEPENDENCE OF THE TOTAL CROSS SECTIONS OF RADIOACTIVE NUCLEI. Vertebnyi, V. P.; Vorona, P. N.; Kolotyi, V. V.; Nechitailo, V. L.; Pshenichnyi, V. A.; Khalov, V. G.; Yarmolenko, N. Ya. (Inst. for Nuclear Research, Kiev). pp 255-261 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

An instrument for measuring neutron cross sections of radioactive nuclei is described. (2 figures) (auth)

3885 CHEMICAL EFFECTS ON INTERNAL CONVERSION IN ^{125}Te. Martin, B.; Schule, R. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett., 46B: No. 3, 367-368(1 Oct 1973).

Internal conversion line intensities were measured for the 35.5 keV M1 transition in ^{125}Te with the use of different chemical compounds. Differences in valence-shell intensities lead to the evaluation of electron densities at the nucleus and to an interpretation of Moessbauer chemical isomer shifts. (auth)

3886 PROBABILITY OF K-SHELL AUTO-IONIZATION IN THE β^--DECAY OF ^{143}Pr. Van Eijk, C. W. E.; Kooy, R. W. (Delft Univ. of Tech., Netherlands). Phys. Lett., 46B: No. 3, 351-352(1 Oct 1973).

The K-shell auto-ionization probability in the β^--decay of ^{143}Pr was measured in a new method using a curved-crystal spectrometer. A value of (2.88 ± 0.20) × 10^{-4} was obtained for the number of K-shell vacancies per β^--decay. This result is compared with previous results and with theory. (auth)

3887 OPTIMUM Q-VALUE IN ^{16}O INDUCED REACTIONS ON EVEN Zr ISOTOPES. Rehm, K. E.; Henning, W.; Mueller, R.; Richter, M.; Rother, H. P.; Schaller, H. (Technische Univ., Munich). Phys. Lett., 46B: No. 3, 353-355(1 Oct 1973).

Angular behavior and optimum Q-value of ^{16}O induced transfer reactions on the even Zr isotopes were studied near the Coulomb barrier as a function of various parameters. The results are compared to semiclassical estimates including recoil effects and nuclear distortions of the Coulomb trajectories. (auth)

3888 CONVERSION ELECTRONS OF ^{116}In FOLLOWING NEUTRON CAPTURE. Schreckenbach, K.; Suarez, A. A.; von Egidy, T. (Technische Univ. Munich, Garching, Ger.). Z. Naturforsch.; 28a: No. 8, 1308-1312(1973).

The reaction ^{115}In(n,e)^{116}In was measured with the beta spectrometer at the FRM reactor in Munich. Multipolarities of 44 transitions up to 600 keV were determined. The spin and parity assignments in the level scheme of Rabenstein et al. are verified by this measurement. New spins and parities could be assigned to 16 levels. (orig.) (GE)

3889 PENETRATION PARAMETER AND M1–E2 MIXING RATIO FOR 145 keV TRANSITION IN ^{141}Pr. Ramaniah, K. V.; Raju, G. K.; Reddy, K. V. (Andhra Univ., Waltair, India). Indian J. Phys.; 47: No. 6, 374-376(Jun 1973).

A study is made of the penetration parameter and the mixing ratio for the M1–E2 145-keV transition in praseodymium-141 using the L subshell intensity ratios of Gelletly et al (1968) as an attempt to obtain a more accurate result for the mixing ratio and more precise range for the penetration parameter. (JFP)

3890 0^+ LEVELS IN ^{130}Xe NUCLEUS. Bakiev, S. A.; Baskova, K. A.; Vasil'ev, S. S.; Mokhsen, M. A.; Sorokin, A. A.; Chutai, T. V. (Moscow State Univ.). Yadern. Fiz.; 18: No. 2, 233-238(Aug 1973). (In Russian).

The β spectrum of ^{130}Cs was measured by means of a spectrometer with the Si(Li) detector. Near the upper boundary of the β spectrum at the electron energy of about 1982 keV a peak was observed that was identified as a K-conversion electron line of the E0-transition with the energy of 2016 keV. On this basis, the quantum numbers $I^\pi = 0^+$ are assigned to the 2016 keV level of ^{130}Xe. (auth)

Nuclear Properties and Reactions, $150 \leq A \leq 189$

Refer also to abstracts 3680, 3778, 3784, 3809, 3823, 3826, 3827, 3857, 3867, 3874, 3878, 3881, 3882, 3947, 3948, 3969, 3974, 3985, 3993, 4045, 4046, 4056, 4105, and 4107.

3891 (COO-1672-47) RADIOCHEMICAL INVESTIGATIONS OF NUCLEAR PROPERTIES. Progress Report, October 1972–September 1973. Daly, P. J. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Chemistry). Sep 1973. Contract AT(11-1)-1672. 18p. Dep. NTIS $3.00.

Research on the structure of nuclei in the transitional region A = 180 to 200 is summarized. A list of publications is included. (JFP)

3892 (COO-2176-20) NEUTRON SPECTROSCOPY. Progress Report, July 1, 1972–June 30, 1973. Havens, W. W. Jr.; Melkonian, E.; Felvinci, J.; Rahn, F. (Columbia Univ., New York (USA). Div. of Nuclear Science and Engineering). 1973. Contract AT(11-1)-2176. 37p. Dep. NTIS $4.00.

The main emphasis during the past year has been on analyzing and publishing results and the preparation for the impending start-up of the newly modified Nevis cyclotron. Papers on the separated isotopes of Yb and W have been submitted to the Physical Review. The published results on Er confirm Dyson's theory of level spacing systematics. The total cross section, resonance parameters, and spin–parity values of Na below 300 keV have been submitted for publication. A report on the evaluation of the Γ_γ's of ^{238}U has been distributed. Extensive results on the Er isotopes, ^{232}U, ^{152,154}Sm, ^{151,153}Eu, Fe, La, In, Ta, F, Mg, Al, S, Cl, K and Ca have been obtained. A paper on the precision measurement of the 2200 m/s neutron–proton capture cross section has been submitted for publication. The background for fission measurements has been extensively analyzed, and modifications to the neutron source of the Nevis cyclotron will be made for the next run. New methods of analyzing-low-count-rate data have been developed to eliminate observation of spurious levels. The captive cross sections of thulium and rhodium have been analyzed; and the results, reported. (9 figures, 7 tables) (auth)

For title listings of selected papers see: 3751, 3802, 3893, and 3894.

3893 (COO-2176-20, p 2) RESONANCE PARAMETERS OF ^{181}Ta. Garg, J.; Hacken, G.; Liou, H.; Rainwater, J.; Rahn, R. 1973.

In neutron spectroscopy. Progress report, July 1, 1972–June 30, 1973.

3894 (COO-2176-20, pp 8–9) CAPTURE RESONANCE PARAMETERS OF THULIUM-169 AND RHODIUM-103. Arbo, J.; Felvinci, J.; Melkonian, E.; Rahn, F.; Ho, C.; Havens, W. W. Jr. 1973.

In neutron spectroscopy. Progress report, July 1, 1972–June 30, 1973.

3895 (INR-1468) ENERGY DISTRIBUTIONS OF ALPHA PARTICLES EMITTED IN THE (n,α) REACTIONS INDUCED BY 18-MeV NEUTRONS IN ^{160}Dy, ^{161}Dy, ^{162}Dy, AND ^{164}Dy. Glowacka, L.; Jaskola, M.; Kozlowski, M.; Osakiewicz, W.; Turkiewicz, J.; Zemlo, M. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 11p. Dep. NTIS (U.S. Sales Only) $3.00.

The energy distributions of alpha particles from the (n,α) reactions on ^{160}Dy, ^{161}Dy, ^{162}Dy and ^{164}Dy induced by 18 MeV neutrons were measured using a semiconductor detector technique. (auth)

3896 (JINR-D6-7094, pp 45–47) PHENOMENOLOGICAL APPROACH FOR ROTATIONAL AND QUASI-ROTATIONAL BANDS. May, F. R.; Frauendorf, S.; Muenchow, L.; duy Thang, N. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3897 (JINR-D6-7094, pp 48–49) INFLUENCE OF 1QP-STATE EQUILIBRIUM DEFORMATIONS ON E1 TRANSITION PROBABILITIES. Andrejtscheff, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); May, F. R.; Muenchow, L.; Frauendorf, S. 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3898 (JINR-D6-7094, pp 53–54) DELAYED TRANSITIONS IN ODD-NEUTRON DEFORMED NUCLEI. Andrejtscheff, W.; Manfrass, P.; Rotter, H.; Schilling, K. D.; Seidel, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3899 (JINR-D6-7094, pp 105–107) DETERMINATION OF THE SPINS OF SOME EXCITED STATES OF ^{154}Gd, OBSERVED DURING THE DECAY OF ^{154}Tb. Budzynski, M. (Joint Inst. for Nuclear Research, USSR); Ion-Mikhai, R.; Kuznetsov, V. V.; Morozov, V. A.; Fuya, Kh.; Nedovesov, V. G.; Shukin, G. E.; Muminov, T. M.; Kholbaev, I.; Subotovich, M. 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3900 (JINR-D6-7094, pp 108–109) DECAY OF ^{159}Er. Afanas'ev, V. P. (Joint Inst. for Nuclear Research, Dubna, USSR); Buttsev, V. S.; Vylov, Ts.; Gromov, K. Ya.; Gromova, I. I.; Kalinnikov, V. G.; Aleksandrov, A. 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3901 (JINR-D6-7094, pp 110–111) NANOSECOND LIFETIME MEASUREMENTS IN ODD–ODD NUCLEI. Seidel, W.; Schilling, K. D.; Andrejtscheff, W.; Manfrass, P. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3902 (JINR-D6-7094, pp 112–113) HIGH-SPIN ROTATIONAL STATES IN THE NUCLEI ^{164}Yb AND ^{180}Os. Gippner, G.; Kaun, K. G.; Noibert, V.; Stari, F.; Shul'tse, V.; Frauendorf, S. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3903 (JINR-D6-7094, pp 114–115) GAMMA–GAMMA ANGULAR CORRELATIONS IN ^{165}Er. Ion-Mikhai, R. (Joint Inst. for Nuclear Research, Dubna, USSR); Morozov, V. A.; Fuya, Kh.; Budzynski, M.; Kholbaev, I. 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3904 (JINR-D6-7094, pp 116–117) BAND WITH $K^\pi = 1^-$ IN THE ODD–ODD NUCLEUS ^{166}Ho. Balodis, M. K.; Alksnis, Ya. K.; Tamberg, Yu. Ya. (Inst. of Physics, Riga). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3905 (JINR-D6-7094, pp 118–119) ELECTRON SPECTRUM OF ^{166}Ho. Grigor'ev, E. P.; Zolotavin, A. V.; Kamynov, Sh. V.; Makarov, V. M. (Leningrad State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3906 (JINR-D6-7094, pp 120–121) $\frac{1}{2}$-[541] BAND IN ^{167}Tm AND ^{169}Tm. Funke, L.; Kemnitz, P.; Sodan, H.; Will, E.; Winter, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3907 (JINR-D6-7094, pp 122–123) INVESTIGATION OF THE GAMMA-RAY SPECTRUM OF ^{169}Lu. Aleksandrov, V. S. (All-Union Scientific-Research Inst. of Metrology, Leningrad); Bonch-Osmolovskaya, N. A.; Vylov, Ts.; Gromova, I. I.; Islamov, T. A.; Khamidov, A. Sh. 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3908 (JINR-D6-7094, pp 124–125) INTERNAL CONVERSION ELECTRON SPECTRUM OF ^{169}Yb IN THE REGION UP TO 100 keV. Artamonova, K. P.; Voronkov, A. A.; Grigor'ev, E. P.; Zolotavin, A. V.; Sergeev, V. O. (Leningrad State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3909 (JINR-D6-7094, pp 126–127) CONVERSION ELECTRONS OF ^{171}Lu. Artamonova, K. P.; Grigor'ev, E. P.; Zolotavin, A. V.; Sergeev, V. O. (Leningrad State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3910 (JINR-D6-7094, p 128) X AND GAMMA RADIATION OF ^{173}Lu. Sergienko, V. A.; Balalaev, V. A.; Safonov, L. A. (Leningrad State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3911 (JINR-D6-7094, pp 129-130) NEW LEVELS IN ^{175}Lu EXCITED IN THE ^{176}Yb(p,2n) REACTION. Winter, G.; Andrejtscheff, W.; Funke, L.; Manfrass, P.; Sodan, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3912 (JINR-D6-7094, pp 131-132) MICROSCOPICAL APPROACH FOR THE $\Delta K \neq 1$ BAND MIXING. May, F. R.; Frauendorf, S.; Muenchow, L. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3913 (JINR-D6-7094, pp 133-134) ABSOLUTE γ-RAY TRANSITION PROBABILITIES IN ^{179}Ta AND ^{183}Re. Manfrass, P.; Andrejtscheff, W.; Schilling, K. D. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3914 (JINR-D6-7094, pp 135-136) ROTATIONAL BANDS IN ^{185}Os. Sodan, H.; Fromm, W. D.; Funke, L.; Kemniz, P.; Winter, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3915 (JINR-D6-7094, pp 137-138) STRONGLY PERTURBED ROTATIONAL BANDS IN ^{187}Ir AND ^{189}Ir. Kemnitz, P.; Funke, L.; Sodan, H.; Suess, M.; Winter, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3916 (JINR-D6-7094, pp 165-166) MEASUREMENT OF THE CONVERSION ELECTRON SPECTRUM OF SHORT-LIVED ISOTOPES IN BETA SPECTROGRAPHS. Gromov, K. Ya. (Joint Inst. for Nuclear Research, Dubna, USSR); Lebedev, N. A.; Islamov, T. A.; Khamidov, A. Sh. 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3917 (JINR-D6-7094, p 192) ROTATIONAL BANDS OF THE $\frac{7}{2}^-$ [503] AND $\frac{11}{2}^+$ [615] STATES IN ^{187}Os. Berzin, Ya.; Zodan, Kh.; Kemnitts, P. (Central Inst. of Nuclear Research, Rossendorf, Ger.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3918 (JINR-P3-7376) STUDY OF THE (n,α) REACTION ON DEFORMED NUCLEI. Balabanov, N. P.; Gledenov, Yu. M.; Kim Tkhe Seb; Popov, Yu. P.; Semenov, V. G.; Florek, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The values of the total α-widths of neutron resonances for ^{155}Gd, ^{177}Hf nuclei are presented as well as preliminary data for ^{151}Eu, ^{187}Os and ^{189}Os. The experimental results are compared with the statistical theory predictions. The effect of nuclear deformation on the α-decay of compound-states is discussed. (auth)

3919 (JINR-P4-6990) PHASE SHIFT TRANSITION IN HIGH ANGULAR MOMENTUM STATES. Frauendorf, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 19p. (In Russian). (CONF-730123-2). Dep. NTIS (U. S. Sales Only) $3.00.

From 23rd national conference on nuclear structure and atomic nuclei; Tbilisi, USSR (28 Jan 1973).

The Coriolis-antipairing-effect is studied for the ground state bands of even-even deformed nuclei. The moment of inertia is calculated by means of the Cranking model. Special attention is paid to the question about the stability of the solution. The nuclei of the rare-earth region are studied using single particle wave functions of the Woods-Saxon potential. For the neutron numbers 90 to 96 the moment of inertia becomes an S-shaped function of the angular velocity. In the same region this effect was found experimentally. Some new numbers of nucleons are proposed, where one can expect such an S-shape behavior of the moment of inertia. (auth)

3920 (NP-19865) PROGRESS REPORT 1972/1973. (Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands)). 1973. 101p. Dep. NTIS (U. S. Sales Only) $7.25.

Approval to begin construction of a 250- to 500-MeV linear electron accelerator is reported. The main part of the document is divided into the following sections: nuclear physics with fast electrons, nuclear reactions, beta and gamma spectroscopy, in-beam spectroscopy, theoretical nuclear physics, radio- and nuclear chemistry, technical department, the 250- to 500-MeV high-duty-factor linear electron accelerator (MEA), study group for pion and muon physics, and publications: July 1972–July 1973. Most of the individual items are short, and some summarize work already published. New, unpublished data are presented in several areas including Cu and Pb charge distributions, ^{9}Be magnetic cross sections, ^{1}H(d,pp)n angular distributions, the decay scheme of ^{169}Tm, γ spectra from decay of ^{173}W and ^{174}W, and yield curves from the ^{209}Bi(^{3}He,xn) reaction at 30 to 70 MeV. (RWR)

3921 (USNDC-7) REPORTS TO THE U. S. NUCLEAR DATA COMMITTEE MEETING AT OAK RIDGE NATIONAL LABORATORY, JUNE 18–20, 1973. Jackson, H. E. (comp.) (Argonne National Lab., Ill.). 1973. 291p. (EANDC(US)-181(U); INDC(USA)-56(U)). Dep. NTIS $7.60.

The reports in this document were submitted to the United States Nuclear Data Committee at a meeting at Oak Ridge National Laboratory by nineteen institutions involved in the acquisition of nuclear data. Subjects in the scope of this program include microscopic nuclear cross sections; standard nuclear cross sections and flux standards; gamma-ray production, radioactive decay, and theoretical developments in nuclear structure; and values of nuclear parameters necessary in the description and understanding of fission and other nuclear processes. (RWR)

For title listings of selected papers see: 2762, 3711–3716, 3759, 3783, 3784, 3857–3861, 3922–3927, 3960–3963, and 3992–3994.

3922 (USNDC-7, pp 22-24) DIRECT CAPTURE STUDIES IN Dy-162(n,γ)Dy-163. Cole, G. W.; Mughabghab, S. F.; Chrien, R. E. (Brookhaven National Lab., Upton, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3923 (USNDC-7, pp 56; 59-60) RESONANCE PARAMETERS FOR ^{163}Dy. Liou, H. I. (Columbia Univ., New York). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3924 (USNDC-7, pp 56; 61-63) CROSS SECTION AND RESONANCE PARAMETERS FOR Cu. Rahn, F.; Makofske, W. (Columbia Univ., New York). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3925 (USNDC-7, pp 57; 65; 72-77) EXTENSION OF OUR RESULTS FOR ^{181}Ta. Hacken, G.; Garg, J.; Rainwater, J. (Columbia Univ., New York). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3926 (USNDC-7, pp 79-82) CAPTURE RESONANCE PARAMETERS OF ^{169}Tm AND ^{103}Rh. Arbo, J.; Felvinci, J.; Melkonian, E.; Rahn, F.; Ho, C.; Havens, W. W. Jr. (Columbia Univ., New York). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3927 (USNDC-7, pp 157-161) NEUTRON RESONANCES IN ^{185}Re AND ^{187}Re UP TO 3 keV. Stolovy, A.; Namenson, A. I.; Harvey, J. A. (Naval Research Lab., Washington, DC). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3928 RADIATIVE CAPTURE OF 14.1 MeV NEUTRONS IN ^{138}Ba, W, Pb, AND ^{209}Bi. Potokar, M.; Likar, A.; Cvelbar, F.; Budnar, M.; Hodgson, E. R. (Technical Univ., Ljubljana, Yugoslavia). Nucl. Phys.; A213: No. 3, 525-540(1973).

Spectra of prompt γ-rays due to radiative capture of 14.1 MeV neutrons to bound nuclear states in natural Ba, W, Pb, and Bi, and the corresponding integrated cross sections are presented. The integrated cross sections for ^{138}Ba, W, Pb, and ^{209}Bi are 1600 ± 300 μb, 930 ± 170 μb, 1100 ± 180 μb and 950 ± 180 μb, respectively. The values agree with previous observations that the cross sections depend smoothly on mass number. The high energy parts of the experimental spectra and recently published fast neutron capture excitation functions are compared with those calculated according to the two approaches of the direct-semidirect theory, namely, the surface peaked particle-nucleus interaction and the volume type interaction. It is concluded that purely on the grounds of presently known experimental data one cannot judge which form of the coupling interaction is more appropriate for the description of the fast nucleon capture process. (auth)

3929 VARIATIONAL CALCULATION OF ENERGY SPECTRA OF ROTATIONAL NUCLEI AT HIGH SPINS. Banerjee, B.; Mang, H. J.; Ring, P. (Univ., Munich). Nucl. Phys.; A215: No. 2, 366-382(1973).

The energy spectra of ^{162}Er and ^{168}Yb were calculated using the Hartree-Fock-Bogoliubov theory and the self-consistent cranking model. The recently discovered anomaly of the spectra at high spins is found to arise from both a reduction of the energy gap and a realignment of the angular momenta of paired nucleons in a high j single-particle state due to the Coriolis anti-pairing effect. (auth)

3930 PHOTOELECTRIC EFFECT OF GAMMA-RAYS. Rao, K. S.; Rao, P. V. R.; Rao, B. V. T. (Andhra Univ, Waltair, India). Lett. Nuovo Cim.; 8: No. 6, 373-377 (6 Oct 1973).

Studies on the photoelectric effect of gamma rays are important to obtain information on gamma ray intensities and internal-conversion coefficients, which in turn give information on the nuclear structure. A careful determination of the photoelectric cross sections is made by using the indirect method in pure samples of lead and cadmium at energies of 100 to 662 keV, and a detailed comparison with those measured by using the direct method is made wherever available. (JFP)

3931 K = 0 ROTATIONAL BANDS IN ^{174}Yb. Casten, R.F.; Breitig, D.; Kane, W.R.; Mughabghab, S.F. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 8: No. 3, 1035-1044 (Sept 1973).

The γ deexcitation of three excited $K=0$ rotational bands has been studied following population in the ^{173}Yb(n, γ) reaction at resonant neutron energies of 4.53 and 17.7 eV. The γ rays were detected in singles and coincidence with Ge(Li) detectors. Analysis was also made of the primary radiation. The decay properties of these bands exhibit strong deviations from the Alaga ratios. For the lowest excited $K=0$ band the deexcitation branching ratios resemble those in the even–even Sm, Gd, Yb, and W nuclei. The higher–lying $K=0$ bands in ^{174}Yb decay similarly to those in ^{172}Yb but considerably differently from the lowest $K = 0$ bands in this region. The pairing-vibrational character of the $K=0$ bands in ^{174}Yb, as shown by (p, t) and (t, p) reaction studies, apparently does not greatly alter the relative decay rates for these states. Two–band mixing of each $K=0$ band with the ground band cannot explain all the observed results, nor can three–band mixing involving the γ vibration. The presence of M1 components in the I–I transitions could explain some of the anomalous branching ratios but cannot be a complete explanation. It is suggested that multiband mixing including the excited $K=0$ bands themselves may have to be considered. The two-neutron-transfer-reaction data can also be interpreted in terms of such mixing. The observed similarities between ^{174}Yb and other nuclei in this region suggest a corresponding similarity of mixing effects. (auth)

3932 STUDY OF LOW-LYING 1- STATES IN ^{166,168,170}Er USING THE RESONANT SCATTERING OF BREMSSTRAHLUNG. Metzger, F.R.; Rasmussen, V.K. (Bartol Research Foundation of The Franklin Institute, Swarthmore, Pennsylvania 19081). Phys. Rev. C 8: No. 3, 1099-1103 (Sept 1973).

In addition to the previously known 1^- states of ^{166}Er at 1663 and 1830 keV, levels at 1812 $\pm$ 1 keV (^{166}Er), 1786 $\pm$ 1 keV (^{168}Er), and 1824 $\pm$ 1 keV (^{170}Er) have been excited using electron bremsstrahlung. Based on the observed angular distributions of the scattered photons, all three previously unknown levels were found to have spin 1. Linear polarization measurements using a two–slab Ge(Li) polarimeter led to negative parity assignments for the 1786– and 1824–keV levels but were inconclusive with respect to the less strongly excited 1812–keV level. Below 1.9 MeV, the 1663–, 1786–, and 1824–keV levels are the dominant E1 excitations in their respective isotopes, the partial widths of their ground–state transitions being $\Gamma_0 = 32 \pm 5$, 46 ± 5, and 30 ± 3 meV. The $B(E1;1^- \to \mathrm{g.s.})/B(E1;1^- \to 2_1^+)$ ratios of 0.52 ± 0.02, 0.51 ± 0.02, and 0.53 ± 0.02 differ considerably from the ratio 1.31 ± 0.11 for the 1812–keV level and the reported ratio 0.22 for the 1830–keV 1^- state and are very close to the Alaga value of 0.50 for $K = 0^-$ levels. (auth)

3933 PROPERTIES OF NUCLEUS ^{150}Sm IN THE PHENOMENOLOGICAL COLLECTIVE MODEL. Budnik, A. P.; Seregin, A. A. * (Inst. of Physical Energy, Moscow). Yadern. Fiz.; 18: No. 3, 495-500(Sep 1973). (In Russian).

Energies of levels with positive parity, electric quadrupole moments, reduced probabilities of the E0 and E2 transitions are calculated for the nucleus ^{150}Sm in framework of the phenomenological collective nuclear model with the two-parameter potential energy, depending on the deformation coordinates β and γ. The agreement with the experimental data is mainly qualitative. (auth)

3934 NATURE OF ^{165}Ho EXCITED STATES. Simonenko, V. M.; Sit'ko, S. P.; Shevchenko, V. A. (Kiev State Univ.). Yadern. Fiz.; 18: No. 3, 473-478(Sep 1973). (In Russian).

Nature of excited states of ^{165}Ho found by the authors in the (n, n'γ) reaction and in other works is analysed. The positions of levels and their quantum characteristics are compared with predictions of the pair correlation model. An attempt is made to use the computed values of electromagnetic transition probabilities for explaining the relative intensities of observed γ lines. (auth)

3935 VARIABLE COLLECTIVE INERTIA AND THE TRANSITION FROM SPHERICAL TO DEFORMED SHAPES IN THE Hg-ISOTOPES. Dickmann, F.; Dietrich, K. (Technische Univ., Munich). Z. Phys.; 263: No. 3, 211-225(1973).

The observed sudden increase of the mean square nuclear charge radius between ^{187}Hg and ^{185}Hg is explained as an increase of the nuclear deformation. The zero point vibration was taken into account within the cranking approach. (GE)

3936 RADIATIVE CAPTURE OF NEUTRONS BY RHENIUM ISOTOPES. Bergman, A. A.; Kaipov, D. K.; Konks, V. A.; Romanov, S. A. (Lebedev Inst. of Physics, Moscow). pp 144-149 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev, Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565–P1.

The neutron capture cross sections for rhenium isotopes and natural rhenium were measured on the neutron slowing-down spectrometer in the energy region 0.2 eV to 70 keV. (2 figures, 2 tables) (auth)

3937 LEVEL DENSITY OF COMPOUND NUCLEI IN THE REGION A = 130 TO 200 AND OTHER NUCLEAR PROPERTIES. Vertebnyi, V. P.; Kal'chenko, A. I.; Pasechnik, M. V. (Inst. of Nuclear Research, Kiev). pp 176-181 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565–P1.

Neutron time-of-flight measurements were recently performed on the reactor of the Institute of Nuclear Research (Kiev), and results were obtained on the neutron resonance levels for nuclei in the region A = 130 to 192. These data were used to get the level densities of the compound nuclei for excitations near the neutron binding energy. The dependence of the level densities for fixed excitation energy on the number of neutrons in the nuclei is also discussed. (5 figures) (auth)

3938 STUDY OF THE INTERACTION OF SLOW NEUTRONS WITH ISOTOPES OF A SERIES OF ELEMENTS IN THE MASS NUMBER RANGE 168 TO 192. Vertebnyi, V. P.; Vorona, P. N.; Kal'chenko, A. I.; Kolotyi, V. V.; Pasechnik, M. V.; Pshenichnyi, V. A.; Pisanko, Zh. I.; Rudishin, V. K. (Inst. for Nuclear Research, Kiev). pp 181-188 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

In order to study the isotopic dependence of the nuclear level density, measurements of highly-enriched samples of $^{186, 187, 188, 190, 192}$Os and ^{168}Yb were carried out in the neutron energy region of 0.02 to 1000 eV. Reduced level spacings for the isotopes of Os are changed insignificantly, although they are in the area of the second minimum in the interval of A = 130 to 208. An anomalously small value of the S_0 neutron strength function for ^{192}Os is discussed. (auth)

3939 METHOD FOR THE MEASUREMENT OF TOTAL AND PARTIAL NEUTRON CROSS SECTIONS AT THE VVR-M REACTOR OF THE INSTITUTE FOR NUCLEAR RESEARCH OF THE ACADEMY OF SCIENCES OF THE UKRAINIAN SSR. II. Total Neutron Cross Section of Europium Isotopes in the Energy Range from 0.008 to 0.3 eV. Vertebnyi, V. P.; Vlasov, M. F.; Zatserkovskii, R. A.; Ignatenko, A. I.; Kirilyuk, A. L.; Trofimova, N. A.; Fedorova, A. F. (Inst. for Nuclear Research, Kiev). pp 239-246 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The transmission method for total neutron cross section measurements is described; this method permits evaluation of the influence of different factors on the accuracy of measured values. Total neutron cross sections of ^{151,153}Eu, natural europium, Au, and H_2O are given in the energy region 0.008 to 0.3 eV. Neutron capture cross sections are obtained by the subtraction of the total cross sections, they are equal to 275 ± 14 barns for ^{153}Eu, the scattering cross sections from 9480 ± 300 barns for ^{151}Eu, and 4680 ± 150 barns for natural europium at $v = 2200$ m/s. (4 figures, 3 tables) (auth)

3940 METHOD FOR THE MEASUREMENT OF TOTAL AND PARTIAL NEUTRON CROSS SECTIONS AT THE VVR-M REACTOR OF THE INSTITUTE FOR NUCLEAR RESEARCH OF THE ACADEMY OF SCIENCES OF THE UKRAINIAN SSR. III. Determination of the Total Cross Section for the Scattering of Slow Neutrons by Atomic Nuclei. Vertebnyi, V. P.; Gnidak, N. L.; Lavlenko, E. A.; Rudishin, V. K. (Inst. for Nuclear Research, Kiev). pp 246-254 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The procedure for scattering cross section measurements for thin samples by the time-of-flight method is described. Different types of corrections are discussed. The total neutron scattering cross sections of metal foils of natural Ho, Er, Yb, Dy, and Tm were measured. The neutron energy range was (0.02 to 1.38) eV. The scattering cross sections of metals and oxides were equal; consequently, paramagnetic scattering on Er^{+++}, Ho^{+++}, Dy^{+++}, and Tm^{+++} ions is the same for both substances. The scattering cross sections are tabulated. (2 figures, 1 table) (auth)

3941 SELF-CONSISTENT CALCULATION OF THE GROUND STATE PROPERTIES OF SOME RARE-EARTH NUCLEI. Flocard, H.; Quentin, P.; Vautherin, D. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett., 46B: No. 3, 304-308(1 Oct 1973).

Ground state intrinsic deformation properties of some rare earth nuclei are calculated within the Hartree–Fock approximation using a Skyrme effective interaction. After a careful optimization of basis parameters, calculations were performed with a basis corresponding to 13 spherical oscillator shells. In order to obtain the multipole moments, good numerical convergence is necessary. Calculated quadrupole and hexadecapole moments are in agreement with available experimental data. Ground state binding energies are also well reproduced. (auth)

3942 FINITE-RANGE CALCULATION OF TWO-NEUTRON TRANSFER REACTIONS IN DEFORMED NUCLEI. Takemasa, T. (Osaka Univ.); Yoshida, H. Phys. Lett., 46B: No. 3, 313-316 (1 Oct 1973).

Finite-range DWBA calculations were done for the reaction $^{154}Sm(p,t)^{152}Sm$. The results were compared with those of the zero-range DWBA calculations. It is found that the finite-range effects are considerably large to the shapes of the angular distributions, but are small to the relative magnitude of the cross section for the 2^+ and 4^+ ground-band members to the ground-state transition. (auth)

3943 HYPERFINE FIELD CREATED BY ^{181}Ta IN AN IRON MATRIX. Benski, H. C.; Berthier, J.; Oddou, J. L. (CEN, Grenoble, France). pp 8 of Hyperfine Interactions Detected by Nuclear Radiation. Liege; Univ. Liege (1973). (In French).

From hyperfine interactions detected by nuclear radiation; Liege, Belgium (11 Sep 1973).

The method of perturbed differential angular correlations was used to observe at ambient temperature the Larmor frequency of the intermediate level of the 133-482 γ–γ cascade of titanium-181. The activity obtained in irradiating natural hafnium was introduced by fusion in an iron matrix. A hyperfine field of the order of 620 kOe was deduced. (tr-auth)

3944 CORRECTION MATRIX-ELEMENT EFFECTS ON THE FIRST FORBIDDEN BETA DECAYS OF THE ^{155}Eu NUCLEUS. Bogdan, D. (Inst. of Atomic Physics, Bucharest); Cretu, T.; Macarie, G. Z. Phys.; 263: No. 2, 129-135(1973).

Using an improved form of the Woods–Saxon nuclear model given by Gareev, Ivanova and Kalinikin, the absolute ft values for the one-quasiparticle transitions are calculated starting from the $5/2^+$ [413] ^{155}Eu ground state and having as final states the first three levels belonging to the rotational band with the ^{155}Gd ground state $3/2^-$ [521] as the band head. Satisfactory results are found especially for the $5/2^+$ [413] → $3/2^-$ [521] and $5/2^+$ [413] → $5/2^-$ [521] transitions. The contribution of the correction matrix elements turns out to be of the order of magnitude 0.1 to log ft. (GE)

3945 MEASUREMENT OF THE PARITY MIXING OF THE 501 keV TRANSITION IN ^{180}Hf BY USE OF A BACKSCATTERING POLARIMETER. Schmidt, G.; Simons, L. M. (Univ., Bonn). Z. Phys.; 263: No. 5, 395-400(1973).

The circular polarization of the 501-keV gamma radiation in ^{180}Hf was remeasured by use of a Compton backscattering polarimeter with the single pulse counting technique. The result $P_c = -(1.9 \pm 0.6) \times 10^{-3}$ confirms the strong parity mixing which was previously reported by other groups. (orig.) (GE)

3946 NONSCHEMATIC DESCRIPTION OF NUCLEAR β-DECAY PROCESSES. Hernandez, E. S. (Univ., Buenos Aires); Szybisz, L.; Plastino, A. Z. Phys.; 263: No. 5, 401-406(1973).

The log ft values for beta transitions in the deformed heavy rare earth nuclei are examined. The effects of the schematic approximation in the treatment of the residual interaction are discussed. It is found that this approach overestimates the beta transition rates by almost an order of magnitude. (orig.) (GE)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 3680, 3746, 3773, 3778, 3784, 3795, 3801, 3815, 3867, 3880–3882, 3891, 3920, 3928, 3930, 3937–3939, 3941, 4045, 4105, and 4380.

3947 (JINR-D6-7094, pp 27-28) EFFECT OF PAIRING CORRELATION OF NUCLEONS OF SUBACTINIDE NUCLEI. Itkis, M. G.; Mul'gin, S. I.; Okolovich, V. N. (Inst. of Nuclear Physics, Alma-Ata, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3948 (JINR-D6-7094, pp 29-30) EFFECTIVE MOMENTS OF INERTIA OF SUBACTINIDE NUCLEI. Itkis, M. G.; Okolovich, V. N.; Rus'kina, G. Ya. (Inst. of Nuclear Physics, Alma-Ata, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3949 (JINR-D6-7094, pp 51-52) SYSTEMATICS OF EXCITED LEVELS OF ODD ISOTOPES OF MERCURY. Dzholos, R. V.; Makhunka, I.; Mate, E.; Fenesh, T. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3950 (JINR-D6-7094, pp 139-140) GAMMA-RAY SPECTRUM IN THE REACTION $^{192}Os(n,\gamma)^{193}Os$. Neiburg, L. A.; Prokof'ev, P. T.; Simonova, L. I. (Inst. of Nuclear Physics, Riga). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3951 (JINR-D6-7094, pp 141-142) ISOMERIC STATES IN THE NUCLEI ^{199}Bi AND ^{201}Bi. Gippner, P.; Kaun, K. G.; Noibert, V.; Stari, F.; Shul'tse, V. (Joint Inst. for Nuclear Research, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3952 (JINR-D6-7094, pp 143-144) DECAY OF THE ISOMERIC STATES ^{199m}Po AND ^{201m}Po. Korman, A.; Khlebovska, D.; Kempisty, T.; Kharatym, Z.; Khoinatski, S. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3953 (JINR-D6-7094, pp 145-146) STUDY OF THE GAMMA EMISSION SPECTRA DURING THE DECAY OF ^{205}Rn AND ^{207}Rn. Zelinski, A.; Zuber, K.; Zuber, Ya.; Kolachkovski, A.; Kuznetsov, V. V.; Lyatushinski, A.; Novseev, Yu. V.; Penev, I.; Potempa, A. V.; Chumin, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3954 (JINR-D6-7094, pp 147-148) γ EMISSION OF THE ISOMER ^{206m}Bi. Burminskii, V. P.; Kovrigin, O. D.; Sychikov, G. I. (Inst. of Nuclear Physics, Alma Ata, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3955 (JINR-D6-7094, pp 149-150) STUDY OF THE GAMMA-RAY SPECTRUM IN THE DECAY OF ^{206}Rn. Zelinski, A.; Zuber, K.; Zuber, Ya.; Kolachkovski, A.; Kuznetsov, V. V.; Lyatushinski, A.; Norseev, Yu. V.; Penev, I.; Potempa, V. A.; Chumin, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3956 (JINR-D6-7094, pp 151-152) DECAY OF ^{208}Rn. Vylov, Ts.; Gasior, M.; Golovkov, N. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3957 (JINR-D6-7094, pp 153-155) LOWER EXCITED STATES OF ^{208}At EXCITED DURING THE DECAY OF ^{208}Rn. Multipole Order of the Low-Energy Transitions in ^{208}At. Afanas'ev, V. P.; Gasior, M.; Golovkov, N. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3958 (JINR-D6-7094, pp 156-157) DECAY OF ^{210}Rn. Excited States of ^{210}At. Afanas'ev, V. P.; Vylov, Ts.; Gasior, M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3959 (JINR-D6-7094, pp 158-160) DECAY OF ^{212}Fr. Golovkov, N. A.; Mikhailova, M. A.; Gasior, M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3960 (USNDC-7, pp 16-18) GIANT M1 RESONANCE IN ^{207}Pb. Medsker, L. R.; Jackson, H. E. (Argonne National Lab., IL). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3961 (USNDC-7, pp 36-43) 24.3 keV NEUTRON BEAM FACILITY AT THE HFBR. Wasson, O. A.; Chrien, R. E.; Greenwood, R. C. (Brookhaven National Lab., Upton, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3962 (USNDC-7, pp 49-52) STUDY OF LEVELS IN ^{200}Hg. Breitig, D.; Casten, R. F.; Cole, G.; Kane, W. R. (Brookhaven National Lab., Upton, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3963 (USNDC-7, pp 264-265) (p,n) REACTION DATA: STUDIES ON HEAVY ELEMENTS. Fielding, H.; Goodman, C. D.; Lind, D. A.; Rickertsen, L. D.; Schery, S. D.; Zafiratos, C. D. (Univ. of Colorado, Boulder). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3964 A PRIORI PRE-EQUILIBRIUM DECAY MODELS. Blann, M. (Univ. of Rochester, NY). Nucl. Phys.; A213: 570-588(1973).

Intranuclear transition rates for a priori calculations of pre-equilibrium decay were calculated using both the imaginary optical potential and a nucleon-nucleon scattering approach which is improved over earlier results used in the geometry dependent hybrid model. Spectra calculated using these intranuclear transition rates in several formulations of the hybrid model are compared with each other and with experimental results for the reactions ^{209}Bi(p,p′) and ^{54}Fe(p,p′) at incident proton energies of 39 and 62 MeV. Results calculated in several ways are found to be in reasonable agreement with data in view of the uncertainties of the calculation. It is shown that the initial target-projectile interaction may be treated as a direct reaction term for which it is essential to consider the geometry of the reaction with respect to the nuclear density distribution but, based on estimated nucleon mean free paths, higher order pre-equilibrium terms may be treated in a nonlocalized fashion. It is also shown that the relative lifetime dependences assumed in many exciton model calculations are in reasonable agreement with results from nucleon-nucleon scattering calculations at excitation energies below 25 MeV, but get progressively poorer at higher excitations. (auth)

3965 SEARCH FOR SUPERHEAVY ELEMENTS AND ACTINIDES PRODUCED BY SECONDARY REACTIONS IN A TUNGSTEN TARGET. Batty, C. J. (Rutherford High Energy Lab., Chilton, Eng.); Kilvington, A. I.; Weil, J. L.; Newton, G. W. A.; Skarestad, M.; Hemingway, J. D. Nature (London); 244: No. 5416, 429-430 (17 Aug 1973).

Evidence was presented earlier by the authors (Nature 229: 464(1971)) for the possible existence of a superheavy element with atomic number 112. This evidence came principally from the observation of spontaneous fission activity in a Hg source separated from a W target irradiated with 24 GeV protons, and it was subsequently shown that, at a later stage, 70% of the fission activity was due to ^{252}Cf. The origin of the remaining 30% was unexplained. Experiments have since been carried out with other targets, the results of which are described. As the previous evidence was based on the possible production of eka-Hg, the chief aim of the experiments was to separate eka-Hg from the W target. As well as looking for possible superheavy elements a search was made for actinides. Details are given of the chemical separation methods. Counting experiments gave no evidence of superheavy elements and no known transplutonium elements were observed. It was, of course, not certain that the eka-element would follow its homologue in the chemical procedures, and it is possible this could be the reason for the negative results. The later experiments thus still did not explain the origin of the fission activity observed in the Hg source in the earlier experiments. It is concluded that the secondary reaction process is unlikely to be a useful way of producing superheavy elements, and that future experiments must rely on direct heavy ion reactions. (UK)

3966 SEARCH FOR SUPERHEAVY ELEMENTS IN NATURAL AND PROTON-IRRADIATED MATERIALS. Geisler, F. H.; Phillips, P. R.; Walker, R. M. (Washington Univ., St. Louis). Nature (London); 244: No. 5416, 428-429(17 Aug 1973).

An improved method of measuring low levels of spontaneous fission was used to establish limits for postulated superheavy elements in natural materials. An ultralow-level counting scheme was employed to detect fission fragments from any superheavy nuclei present, fission fragments being recorded as coincidence counts in two adjoining plastic detectors. Details are given of the experimental technique, which was carried out in the Fairport Harbor Salt Mine, 585 m. below the surface, to avoid induced fissions from cosmic rays. Samples of the chemical homologues (Pb, Hg, Pt, etc.) of all possible superheavy elements from $Z = 108$ to $Z = 114$ were examined, most being naturally occurring ores, plus some industrial concentrates. A sample of galena irradiated with 9.4×10^{17} protons at 29 GeV/c and a sample of $ThCl_4$ were also examined. Allowance was made for spontaneous fission fragments from U impurities. Of 40 samples 30 showed no fission events, eight showed one, one showed three, and one showed five. It was concluded that no evidence had been found for the existence of a superheavy element, at least at concentrations $<7.6 \times 10^{-13}$, $<4.5 \times 10^{-18}$, or $<2.9 \times 10^{-13}$ relative to the heavy homologue. The negative results also indicate that the spontaneous fission half-lives of Pb, Hg and Th are $>3.8 \times 10^{22}$ yr., $>3.6 \times 10^{22}$ yr., and $>2.4 \times 10^{20}$ yr., respectively. No spontaneous fission events were recorded with the galena sample. A null count for the proton irradiated sample of galena also sets an upper limit of 3.6 pbarn for the production of ^{252}Cf by impact of 29 GeV/c protons. It seems likely that a more fruitful approach to the search for superheavy elements may lie in studies of heavy ion reactions in high atomic number targets. (UK)

3967 BEHAVIOR OF THE PARTICLES TRANSFERRED IN THE ^{16}O + ^{197}Au AND ^{12}C + ^{197}Au REACTIONS. Eyal, Y.; Beg, K.; Logan, D.; Miller, J.; Zebelman, A. (Department of Chemistry, Columbia University, New York, New York 10027). Phys. Rev. C 8: No. 3, 1109-1122 (Sept 1973).

The reactions between ^{197}Au and 166-MeV ^{16}O, 135-MeV ^{16}O, and 125-MeV ^{12}C have been investigated through the measurement of (1) energy and angular distributions of emitted light particles ranging from Li to N, (2) production cross sections of selected radioactive products ranging from ^{192}Au to ^{209}Po, and (3) recoil ranges of a few of these radioactive products. From the results, information can be obtained on the probability that the intermediate excited heavy nuclei produced by the transfer of energy and nucleons from the incident projectile to the heavy target deexcite in a manner consistent with statistical equilibration of the excitation energy. The course of the transfer reactions is qualitatively discussed in terms of the semiclassical deflection function for the reacting systems. (auth)

3968 ELASTIC SCATTERING OF LOW-ENERGY PIONS AND MUONS FROM LEAD. Dugan, G.; Childress, S.; Lederman, L.M.; Price, L.E.; Sanford, T. (Columbia University, New York, N. Y.). Phys. Rev. C 8: No. 3, 909-921 (Sept 1973).

The small-angle (13°–40°) part of the elastic differential cross section for the scattering of low-energy ($T_\pi \approx 100$ MeV) positive and negative pions from natural lead was measured. The same quantity was also measured for the scattering of low-energy muons from lead. The muon–lead data were used to determine the rms charge radius of the lead nucleus. Assuming a Fermi shape for the charge density with a skin thickness of 2.21 fm, the result was $\langle r^2 \rangle_{ch}{}^{1/2} = 5.50 \pm 0.06$ fm. The $\pi^\pm$–Pb data, taken in the region of large Coulomb nuclear interference, were compared with predictions of the pion–nucleus optical model according to Watson and Kisslinger. Excellent fits to the data were obtained by treating the model phenomenologically; however, the best-fit optical-model parameters were not in agreement with the values computed from experimental pion–nucleon phase shifts. Since the $\pi^\pm$–Pb elastic cross sections are sensitive to the neutron density distribution, a determination of the rms neutron–matter radius could be made. Assuming a Fermi shape for the neutron–matter density, with a skin thickness of 2.21 fm, the result was $\langle r^2 \rangle_{n.m.}{}^{(1/2)} = 5.45^{+0.13}_{-0.25}$ fm. (auth)

3969 NUCLEAR SCATTERING OF PLANE-POLARIZED PHOTONS. Hayward, E. (National Bureau of Standards, Washington, D. C. 20234); Barber, W.C.; Sazama, J. Phys. Rev. C 8: No. 3, 1065-1073 (Sept 1973).

A beam of plane-polarized monochromatic photons has been produced by the resonance fluorescence of the well-known 1^+ state at 15.1 MeV in ^{12}C. These have been scattered a second time from natural targets of Cd, Sn, Ta, W, Pt, Au, and Bi. Measurements were made with poor energy resolution of the relative number of photons scattered at 90° parallel and perpendicular to the polarization vector in the incident 15.1-MeV beam. The observation of photons scattered along the polarization vector reflects the contribution of incoherent scattering to the dominant coherent-scattering process and results either from permanent nuclear deformation or from the dynamic deformation produced by the coupling of the giant dipole resonance with the quadrupole oscillations of the nuclear surface. The observed intensities of incoherent scattering are of the same order of magnitude for the deformed nuclei and the spherical vibrators and agree roughly with the predictions of the dynamic collective model. No incoherent scattering was observed from the rigid sphere ^{209}Bi. (auth)

3970 π^+-MESON DOUBLE CHARGE-EXCHANGE ON NUCLEI ^{209}Bi. Batusov, Yu. A.; Ganzorig, Zh.; Dudova, I. V.; Osipenko, B. P.; Sidorov, V. M.; Khalkin, V. A.; Chultem, D. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 3, 485-491(Sep 1973). (In Russian).

π^+-meson double charge exchange reactions on bismuth nuclei $\pi^+ + {}^{209}\text{Bi} \rightarrow {}^{209}\text{At}^{-x} + \pi^- + xn$, are investigated. The astatine, or the daughter product, polonium, isotopes were identified registering the α particles and measuring their energies. The cross section of the reaction $\pi^+ + {}^{209}\text{Bi} \rightarrow \pi^- + {}^{207}\text{At} + 2n$ is found to be $(12 \pm 3) \cdot 10^{-29}$ cm^2. Estimate of upper bound for the π^+-meson elastic double charge-exchange on Bi nuclei is $\leq 10^{-29}$ cm^2. A possible mechanism of formation of ^{211}At in the reaction $\pi^+ + {}^{209}\text{Bi} \rightarrow {}^4\text{He} + \ldots, {}^4\text{He} + {}^{209}\text{Bi} \rightarrow {}^{211}\text{At} + 2\text{n}$ is considered. (auth)

3971 LOW-ENERGY LEVEL STRUCTURE AND THE ELECTROMAGNETIC PROPERTIES OF ^{191}Ir AND ^{193}Ir. Chopra, R. C. (Tata Inst. of Fundamental Research, Bombay). Z. Phys.; 263: No. 2, 137-146(1973).

The M1 and E2 reduced transition probabilities in ^{191}Ir and ^{193}Ir were calculated on the weak particle-core coupling model. The static moments of the ground state and the first three low lying excited states were computed. The theoretical values are in good agreement with the experimental results, in particular, the existing discrepancy between the theoretical and the experimental value for the magnetic moment of the first excited $\frac{5}{2}^+$ state, in both these nuclei, was removed. The predicted sign of the quadrupole moment of the 2^+ state in the neighboring even–even nuclei is consistent with the results reported for platinum nuclei. The level structure of both these nuclei was calculated assuming the particle-core interaction to be dipole–dipole and quadrupole–quadrupole type. (GE)

3972 MEASUREMENT OF THE TOTAL CROSS SECTION OF LEAD IN THE RESONANCE ENERGY REGION. Muradyan, G. V.; Adamchuk, Yu. V.; Shchepkin, Yu. G. (Inst. of Atomic Energy, Moscow). pp 124-127 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

A new method for measuring the absolute value of the total cross section in the region where the resonance structure is absent, based on the measurements of neutron transmission by means of resonance capture, was suggested. The absolute values of total cross section of lead in the energy range up to ~0.5 keV were obtained by this method by using capture into ^{123}Sb resonances. (1 table) (auth)

3973 ELASTIC SCATTERING OF NEUTRONS BY ^{208}Pb AND THE OPTICAL MODEL OF THE NUCLEUS. Morozov, V. M.; Zubov, Yu, G.; Lebedeva, N. S. (Inst. of Atomic Energy, Moscow). pp 267-272 of Neitronnaya Fizika, Chast' I. Gilelakh, V. I. (ed.). Kiev; Kzdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The differential cross sections for elastic scattering of neutrons with $E_n = (1.8 \pm 0.2)$ MeV from 12 to 168° were measured with two neutron beams. In the second beam the neutron intensity in the energy ranges corresponding to the total cross section resonances of ^{208}Pb was decreased by an order of magnitude or more as compared with the first beam. The difference in the observed cross sections is discussed in accordance with the concept of two neutron scattering processes: shape-elastic scattering and compound-elastic scattering. (1 figure) (auth)

3974 METHOD FOR THE MEASUREMENT OF TOTAL AND PARTIAL NEUTRON CROSS SECTIONS AT THE VVR-M REACTOR OF THE INSTITUTE FOR NUCLEAR RESEARCH OF THE ACADEMY OF SCIENCES OF THE UKRAINIAN SSR. I. Use of Two Detectors for the Measurement of the Total Cross Section in the Thermal Region. Vertebnyi, V. P.; Vorona, P. N.; Kal'chenko, A. I.; Rudishin, V. K.; Pshenichnyi, V. A.; Stolyarevskii, I. P.; Trofimova, N. A. (Inst. for Nuclear Research, Kiev). pp 232-239 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The transmission measurements of powdery specimens may be affected by small angle scattering, which may take place in the "good geometry" conditions of the experiment; the contribution of this effect to the total neutron cross section may be rather large. A method of taking account of this phenomenon, using a system of two detectors, is suggested. The results for a sample of ^{192}Os suggest the necessity of accounting for this effect. (auth)

3975 DISTRIBUTION OF NUCLEAR MAGNETIZATION IN MERCURY ISOTOPES. Moskowitz, P. A.; Lombardi, M. (Univ., Grenoble, France). Phys. Lett., 46B: No. 3, 334-336(1 Oct 1973).

Examination of the systematics of ten mercury isotopes, for which there exist precision measurements of both the nuclear magnetic dipole moments and hfs interaction constants A(6s6p $^3P_1$), shows a relation between the magnetic moments and the magnetic dipole hfs anomalies. (auth)

3976 COMPLEX COUPLING INTERACTION IN THE RADIATIVE CAPTURE OF FAST NUCLEONS. Potokar, M. (Univ. of Ljubljana, Yugoslavia). Phys. Lett., 46B: No. 3, 346-350(1 Oct 1973).

The theory of fast nucleon radiative capture is refined by replacing the original real nucleon-nucleus coupling interaction by a complex one, having a real part of volume form and an imaginary surface peaked part. (auth)

3977 SEMI-REALISTIC SHELL MODEL STUDIES IN THE LEAD REGION. II. ^{211}Bi. Baldridge, W.; Freed, N.; Gibbons, J. (Pennsylvania State Univ., University Park). Phys. Lett., 46B: No. 3, 341-345(1 Oct 1973).

The semi-realistic approach described earlier is applied to a calculation of the $^{208}\text{Pb} \pm 3$ nucleus ^{211}Bi. It is shown that the anomalously low lying $\frac{7}{2}^-$ first excited state arises from the particularly strong coupling between the $f_{7/2}$ single-proton state and the $\frac{7}{2}^-$ member of the $i_{13/2} \otimes {}^{208}\text{Pb}(3^-)$ core multiplet. (auth)

3978 HYPERFINE STRUCTURE INVESTIGATIONS IN THE $^4F_{9/2}$ ATOMIC GROUND STATE OF ^{191}Ir AND ^{193}Ir. Buettgenbach, S.; Herschel, M.; Meisel, G.; Schroedl, E.; Witte, W.; Childs, W. J. (Univ., Bonn). Z. Phys.; 263: No. 4, 341-346(1973).

The $5d^76s^2$ $^4F_{9/2}$ atomic ground state of ^{191}Ir and ^{193}Ir was studied using the atomic-beam magnetic-resonance method. The hfs splittings and the interaction constants A, B, and C were determined. Using the magnetic dipole moments known by NMR-technique are obtained for the electric quadrupole moments as calculated from the hyperfine interaction constants A and B: $Q(^{191}\text{Ir}) = 0.78(20)$ barns, $Q(^{193}\text{Ir}) = 0.70(18)$ barns (uncorrected for core polarization effects). A calculation of the hyperfine anomaly yields: ${}_{191}\Delta_{193} = -0.00023(10)$. (GE)

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Refer also to abstracts 3259, 3680, 3681, 3746, 3880, 3881, 3921, 3963, 3966, 4006, 4380, and 4544.

3979 (AERE-R–7548) REVIEW OF FISSION PRODUCT YIELD DATA FOR FAST NEUTRON FISSION. Cuninghame, J. G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Sep 1973. 88p. Dep. NTIS (U. S. Sales Only) $6.50.

This paper summarizes the current position on fast fission yields, including cumulative and independent yields, the effect of change of neutron energy, 14 MeV yields, and ternary fission. Tables of data from recent yield evaluations are presented and compared, and new data not yet included in evaluations are given. Recommendations are made for measurements needed to fill the many large gaps in the data. (auth)

3980 (CEA-N-1632) SENSITIVITY OF FAST NEUTRON SPECTRA AND INTEGRAL PARAMETERS TO ^{238}U INELASTIC

SCATTERING CROSS SECTIONS. Paviotti Corcuera, R. (CEA Centre d'Etudes Nucleaires de Cadarache, 13–Saint-Paul-les Durance (France)). May 1973. 68p. (In French). Dep. NTIS (U. S. Sales Only) $5.50.

Fast neutron spectrum measurements by time-of-flight or proton recoil techniques are a new type of integral measurements permitting to adjust scattering cross sections. Important discrepancies between experimental and calculated spectra are observed, which can at least partly be attributed to errors in the ^{238}U inelastic scattering matrix. The sensivity of the macroscopic spectra (25-group energy mesh) and integral parameters to the inelastic scattering cross sections of ^{238}U was studied in two cases: in fundamental mode for three media with different contents of ^{238}U and space dependent calculations in a fast core reflected by two different ^{238}U blankets. (FR)

3981 (CONF-731101-5) TESTING OF ^{238}U PHOTON PRODUCTION DATA FROM ENDF/B MATERIALS 58, 702, AND 4187. Ford, W. E. III. (Oak Ridge National Lab., Tenn. (USA)). 1973. 8p. Dep. NTIS $3.00.

Photon production data from three sets of ^{238}U ENDF/B data, MAT's 58, 702, and 4187, mod 1 were tested by using the data to calculate secondary gamma-ray pulse height spectra that could be compared with measured spectra. This project also provided a test of the AMPX modular code system for generating coupled neutron-gamma multigroup cross section data. (LBS)

3982 (EURFNR-1100) DETERMINATION OF THE U-235 FISSION CROSS-SECTION FOR NEUTRONS WITH ENERGY VALUES BETWEEN 500 AND 1200 keV. Kaeppeler, F. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Apr 1973. 99p. Dep. NTIS $7.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Due to the importance of the ^{235}U fission cross section for reactor design as well as a secondary standard, an absolute measurement was performed between 0.5 and 1.2 MeV neutron energy. Using a fast pulsed neutron source for background discrimination and a new method for flux determination, the total uncertainty of seven absolute values could be reduced to about 3%. In addition twelve relative values allowed a detailed description of the cross section shape. Structure in the fission cross section at about 950 keV was found and is thought to be caused by the end of the energy gap in the compound nucleus ^{236}U. The resulting deformation dependence of the gap parameter Δ is discussed. (auth)

3983 (INIS-mf-777) COMPETITION BETWEEN THE EMISSION OF PHOTONEUTRONS AND THE PHOTOFISSION OF ^{238}U AND ^{232}Th NEAR THE THRESHOLD. Mafra, O. Y. (Sao Paulo Univ. (Brazil)). 1971. 129p. (In Portuguese).

Several models were considered to interpret the competition between the emission of photoneutrons and photofission of ^{238}U and ^{232}Th. Experimental data showed that the "constant temperature" model gave the best results for exciting energies in the range 6 to 9 MeV. It was observed that above 8.5 MeV the relation is independent of the excitation energy. (auth)

3984 (JINR-D6-7094, pp 161-162) GAMMA EMISSION SPECTRUM OF ^{222}Fr. Afanas'ev, V. P.; Vylov, Ts.; Golovkov, N. A.; Gromova, I. I.; Dzhelepov, B. S.; Ivanov, R. B.; Kolachkovski, A.; Mikhailova, M. A.; Novseev, Yu. V.; Chumin, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

3985 (JINR-P4-7224) MAGNETIC MOMENTS OF ODD-MASS DEFORMED NUCLEI IN THE NON-ADIABATIC MODEL. Baznat, M. I.; Pyatov, N. I.; Chernei, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

In the conventional unified model the effective gyromagnetic factors g_R^{eff} and g_s^{eff} are considered as parameters entering in the magnetic moments and intraband MI–transition probability. Equations for those factors in the framework of the non-adiabatic rotational model for odd-mass nuclei. The difference between g_s^{eff} and the free nucleon value g_s as well as that between g_R^{eff} and the g_R^0 value for the even-even core is closely related to non-adiabatic corrections to the energy of rotational states in odd-mass nuclei. This allows one to study the behavior of effective g-factors within rotational band using the g_R^0 value as a parameter, and the nonadiabatic wave functions obtained from the fit of calculations to experimental rotational energies. In particular, for the states of the yrast-line the following relations were obtained between g_R^0 and g_R^{eff} in odd-N and odd-Z nuclei: $g_R^{eff}(N) \leq g_R^0 \leq g_R^{eff}(Z)$. It is shown that due to the Coriolis force the g-factors may strongly vary with spin and that the longitudinal and transverse spin polarization effects cannot be exactly separated. The systematic calculations of the magnetic dipole moments are performed for rare-earth and actinide nuclei employing the single-particle model with the Saxon-Woods potential well. The calculated magnetic moments for the low energy states are not very sensitive to the value of g_R^0, which is found to be of the same order of magnitude as in even-even nuclei. (auth)

3986 (JINR-P7-7189) POSSIBILITY OF PRODUCTION OF TRANSURANIUM ELEMENT ISOTOPES IN THE REACTIONS OF INCOMPLETE FUSION WITH HEAVY IONS. Artyukh, A. G.; Volkov, V. V.; Gridnev, G. F.; Il'inov, A. S.; Mikheev, V. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The estimates are given for the production cross sections of isotopes of elements with $94 \leq Z \leq 100$ when bombarding ^{238}U by 172 MeV ^{22}Ne ions and by 288 and 379-MeV ^{40}Ar ions. The estimates are made on the basis of the analysis of experimental data on cross sections and on the energy spectra of light products of multinucleon transfer reactions. (auth)

3987 (JINR-P7-7279) EXPERIMENTS ON SUPERHEAVY ELEMENT SYNTHESIS IN THE REACTIONS WITH ACCELERATED Zn IONS. Pleve, A. A.; Demin, A. G.; Kush, V.; Miller, M. B.; Danilov, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The experiments are described on synthesis of super-heavy elements in the reactions induced by accelerated Zn ions. The experimental technique was reckoned upon the recording of spontaneous fission during operation with the external cyclotron beam. Experimental boundaries are given for production cross sections and the lifetime of super-heavy nuclei. (auth)

3988 (JINR-P7-7327) MASS AND CHARGE DISTRIBUTIONS OF FISSION FRAGMENTS IN REACTIONS WITH ACCELERATED Kr AND Xe IONS. Oganesyan, Yu. Ts.; Penionzhkevich, Yu. E.; Nguen Tac An; Adamek, A.; Ngo Kuok Byu; Nguyen Mong Shin. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The mass and charge distributions of the fission products resulting from the fission of heavy nuclei produced by the reactions ^{181}Ta + ^{84}Kr, ^{181}Ta + ^{136}Xe, ^{238}U + ^{136}Xe and ^{238}U + ^{129}Xe were studied. On the basis of the data obtained, the mechanism of the formation of fission fragments and the possibilities of using the fission reaction induced by ions with mass $A > 100$ to synthesize new neutron-rich heavy nuclei, particularly in the predicted region of stability of superheavy nuclei, are discussed. (auth)

3989 (JINR-P7-7391) ENERGY DEPENDENCES OF THE FISSION REACTION AND NUCLEON TRANSFER CROSS SECTIONS AT INTERACTION OF ^{232}Th WITH ACCELERATED ^{74}Ge IONS. Oganesyan, Yu. Ts.; Nadkarni, D. M.; Nguyen Thak An; Penionzhkevich, Yu. E.; Pustyl'nik, B. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 17p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The investigation was carried out of the energy dependence of cross sections for fission reactions and nucleon transfer for interactions of ^{232}Th with accelerated ^{74}Ge ions. It is shown that the Coulomb barrier of the fission reaction exceeds that of reaction of transfer of 1 to 5 nucleons to 30 MeV. (auth)

3990 (KFK-1798) NEUTRON SPECTRUM MEASUREMENTS IN A DEPLETED URANIUM METAL BLOCK FOR INVESTIGATION OF DISCREPANT ^{238}U CROSS SECTIONS. Bluhm, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). May 1973. 179p. (In German). Dep. NTIS (U. S. Sales Only) $11.00.

Thesis. Submitted to Karlsruhe Univ. (West Germany).

This report deals with the measurement and interpretation of neutron spectra in a massive block of depleted uranium. In its first part the construction and test of a ^{3}He-semi-conductor-sandwich-spectrometer for in-core spectrum measurements in the energy region from 100 keV to 5 MeV is described which is able to discriminate against γ-background and to correct for energy losses in the target. Using the ^{3}He-spectrometer and spherical proton recoil counters the neutron spectra on the axis of a massive block of uranium metal are measured and compared to calculated multigroup spectra. The sensitivity of the spectra against ^{238}U cross section changes is determined by systematic variation of all relevant nuclear data. These sensitivity studies are then used to deduce ^{238}U capture and inelastic scattering cross sections from discrepancies between theoretical prediction and experiment. The ^{238}U cross sections deduced are able to reproduce the measured spectra at all positions of the uranium block axis within the experimental errors. In addition they lead to a considerably better agreement between experimental and theoretical results for other fast zero power assemblies which are sensitive to ^{238}U cross section changes. (auth)

3991 (ORNL-tr-2711) SPONTANEOUS FISSION OF KURCHATOVIUM AND NILSBORIUM ISOTOPES. Flerov, G. N.; Lazarev, Yu. A.; Lobanov, Yu. V.; Oganesyan, Yu. Ts.; Tret'yakova, S. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1971. Translation by M. Gerrard of JINR-D7-5769. (CONF-710209-5). 13p. Dep. NTIS $3.00.

From international conference on heavy ion physics; Dubna, USSR (11 Feb 1971).

Upon irradiation of plutonium-244 with 109-MeV neon-22 besides the intense short-lived component, an isotope was formed which fissioned spontaneously with a lifetime = 0.014 ± 0.05 sec. The total angular distributions of reaction products and the yield ratio were found. These results were considered as direct proof that the isotope with $\tau_{½} = 0.10 \pm 0.05$ sec is formed in the complete fusion of the interacting nuclei with subsequent evaporation of neutrons from the excited constituent nucleus; therefore it has the atomic number 104. Also the energy dependence of the formation cross sections of spontaneously fissioning products upon irradiation of plutonium-242 with neon-22 ions at 110 to 140 MeV was studied. Also the fragments of spontaneous fission of the isotopes of element 105 formed in the reaction americium-243 + neon-22 were recorded. (JFP)

3992 (USNDC-7, pp 92; 95-98) INTEGRAL PHOTOFISSION EXPERIMENTS NEAR THRESHOLD OF ^{238}U AND ^{232}Th. Gozani, T. (Intelcom Radiation Tech., San Diego, CA). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3993 (USNDC-7, pp 204-206) AVERAGE RESONANCE PARAMETERS IN THE UNRESOLVED RESONANCE REGION OF URANIUM AND TANTALUM. Byoun, T. Y.; Block, R. C.; Semler, T. (Rensselaer Polytechnic Inst., Troy, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3994 (USNDC-7, pp 207-209) SUBTHRESHOLD FISSION INDUCED BY NEUTRONS ON ^{238}U. Block, R. C.; Hockenbury, R. W.; Slovacek, R. E.; Bean, E. B.; Cramer, D. S. (Rensselaer Polytechnic Inst., Troy, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Oak Ridge National Lab.

3995 SYMMETRIC AND ASYMMETRIC FISSION OF ^{226}Ra INDUCED BY 5 TO 15 MeV NEUTRONS. Zhagrov, E. A.; Kuks, I. M.; Nemilov, Yu. A.; Selitskii, Yu. A.; Funstein, V. B. (Radium Inst., Leningrad). Nucl. Phys.; A213: No. 3, 436-444(1973).

Kinetic energy spectra of fragments in the 5 to 15 MeV neutron-induced fission of ^{226}Ra are obtained. The fraction of fragments corresponding to the central peak of the mass yield curve is determined for each neutron energy used. It is shown that at low excitation energies of the ^{227}Ra compound nucleus precluding second-chance fission the mass yield curve retains its triple-peaked nature. At still lower excitations, near the fission threshold, radium undergoes asymmetric fission, just as the heavier nuclei. (auth)

3996 KINETIC ENERGY OF FISSION FRAGMENTS WITH EVEN AND ODD NUMBERS OF PROTONS. Solovjev, S. M.; Eismont, V. P. (Radium Inst., Leningrad). Nucl. Phys.; A213: No. 3, 520-524(1973).

In order to compare the distributions of the prompt energy release in the fission of a doubly even nucleus into even-Z and odd-Z fragments, the spectra of fragment kinetic energy and the coincident K x-rays were measured in a two-parameter mode with high statistical accuracy for the case of ^{252}Cf spontaneous fission. By means of computer spectrum decomposition techniques data were obtained for average kinetic energies of fragments with even and odd atomic number. The comparison did not show any noticeable correlation of the mean fragment kinetic energy with oddness or evenness of the fragments. (auth)

3997 NUCLEAR INERTIAL MASS PARAMETER B IN THE ADIABATIC APPROXIMATION. Stephien-Rudzka, W. (Inst. for Nuclear Research, Warsaw). Acta Microbiol. Pol., Ser. B4: No. 4, 467-487(1973).

The nuclear inertial mass parameter B is investigated by means of two slightly different approaches, both making use of the adiabatic approximation for the collective motion. The numerical results are given for two regions: the superheavy nuclei $108 \le Z \le 124$, $172 \le N \le 188$ and the neutron-rich nuclei $88 \le Z \le 104$, $172 \le N \le 194$. The influence of the choice of the Nilsson model parameters $\varkappa$ and μ is investigated together with the dependence on the deformation parameters ϵ and ϵ_4. (auth)

3998 RELATIVE EXCITATIONS OF THE ^{237}Pu SHAPE ISOMERS. Vandenbosch, R.; Russo, P.A.; Sletten, G.; Mehta, M. (University of Washington, Seattle, Washington 98195). Phys. Rev. C 8: No. 3, 1080-1083 (Sept 1973).

The excitation energy of the 1120-nsec spontaneous-fission isomer of ^{237}Pu has been shown to be 0.30 ± 0.15 MeV above that of the 82-nsec isomer. The half-life of the longer-lived isomer may therefore be determined by its radiation width rather than by its direct fission width. (auth)

3999 FRAGMENT-MASS AND KINETIC-ENERGY DISTRIBUTIONS FROM THE SPONTANEOUS FISSION OF ^{246}Cm. Pleasonton, F.; Ferguson, R.L.; Plasil, F.; Bemis, C.E. Jr. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 8: No. 3, 1018-1022 (Sept 1973).

Energies of coincident fission fragments from a thin, spontaneously fissioning ^{246}Cm source were measured with silicon surface-barrier detectors. Pre-neutron-emission mass and total-kinetic-energy distributions were deduced from the data. The average pre-neutron-emission fragment total kinetic energy $\bar{E}_K$ was found to be 184.2 MeV, in agreement with ^{245}Cm(n, f) results. The mass distribution has a peak-to-valley ratio of 142, and is similar to those from other spontaneously fissioning nuclei. Fine structure in the mass distributions from ^{245}Cm (n, f), ^{246}Cm(sf), and ^{250}Cm(sf) appears to be associated with fragments of mass ≈ 144 amu. Predictions for $\bar{E}_K$ from fission systematics were not found to describe adequately the observed $\bar{E}_K$ values for the spontaneous fission of Cm isotopes. (auth)

4000 FRAGMENT KINETIC ENERGY IN ^{18}O-INDUCED FISSION OF ^{232}Th AND ^{246}Cm. Ferguson, R.L.; Plasil, F. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Freiesleben, H.; Bemis, C.E. Jr.; Schmitt, H.W. Phys. Rev. C 8: No. 3, 1104-1108 (Sept 1973).

On the basis of a static scission model, Schmitt and Mosel have predicted that fragment total kinetic energies E_K are larger than those expected from Viola's fission systematics when $255 \lesssim A \lesssim 280$. In a search for this effect, E_K was measured in ^{18}O bombardments of ^{232}Th and ^{246}Cm. Correlated energies of fission-fragment pairs were measured with silicon surface-barrier detectors; fragment mass and total kinetic energy distributions were deduced. For 102.5-MeV ^{18}O ions, the average pre-neutron-emission fragment total kinetic energy, $\langle E_K \rangle$ was found to be 187 MeV for the ^{232}Th case and 198 MeV for the ^{246}Cm case. The corresponding Schmitt-Mosel predictions are 186 MeV for ^{232}Th and 258 MeV for ^{246}Cm; Viola's predicted values are 185 MeV for ^{232}Th and 203 MeV for ^{246}Cm. It is probable that the predicted high E_K value for ^{246}Cm was not observed because shell effects, which are responsible for the high predicted kinetic energies, have disappeared at the relatively high excitation energies encountered in this work. (auth)

4001 CROSS SECTIONS AND RECOIL PROPERTIES OF XENON ISOTOPES FORMED IN 11.5-GeV PROTON BOMBARDMENT OF ^{238}U. Yu, Y.W.; Porile, N.T. (Department of Chemistry, Purdue University, West Lafayette, Indiana 47907); Warasila, R.; Schaeffer, O.A. Phys. Rev. C 8: No. 3, 1091-1098 (Sept 1973).

Partial cumulative yields and thick-target recoil properties of 14 xenon nuclides formed in the interaction of ^{238}U with 11.5-GeV protons and ranging from ^{122}Xe to ^{136}Xe have been measured. Independent yields and recoil ranges were deduced with the aid of reported data. The isotopic-yield distribution consists of two peaks with a broad region of near-constant yields between them. The recoil ranges exhibit the characteristic dropoff on the near neutron-deficient side of stability. Comparisons with other isotopic- and isobaric-yield distributions and ranges of products in the same mass region are presented. (auth)

4002 PROBABILITY OF FORMATION OF SPONTANEOUSLY FISSIBLE ISOMER STATES AT THERMAL NEUTRON CAPTURE BY NUCLEI ^{235}U AND ^{239}Pu. Val'skii, G. V.; Mrachkovskii, O. M.; Petrov, G. A.; Pleva, Yu. S. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 3, 492-494(Sep 1973). (In Russian).

Ratio of cross section of the spontaneously fissible isomer production σ_i, to the instant fission cross section, σ_f, was measured at the thermal neutron capture by nuclei ^{235}U and ^{239}Pu. The ratio σ_i/σ_f is found to be $(0.29 \pm 0.25) \cdot 10^{-4}$ for the ^{239}Pu target, if one assumes that at populating the isomer state two γ quanta with energies more than 0.7 MeV are emitted. Under the same conditions the upper bound to σ_i/σ_f for the ^{235}U target is $0.5 \cdot 10^{-4}$ at the double standard deviation level. (auth)

4003 ABSOLUTE DETERMINATION OF THE ^{235}U FISSION CROSS SECTION AT 964 keV. Gilliam, D. M. Ann Arbor, MI; Univ. of Michigan (1973). 129p. University Microfilms Order No. 73-24,568.

Thesis (Ph. D.).

A sodium-beryllium photoneutron source emitting essentially monoenergetic neutrons is employed to measure the ^{235}U fission cross section at 964 keV with absolute flux determination. Fission events are recorded by a pair of limited solid angle track-etch detectors. The symmetric arrangement of the source and detectors minimizes geometric uncertainties in the flux determination. Rather thick U_3O_8 deposits (1.1 mg U/cm^2) are allowed by the limited solid angle counting, the oxide masses being known from weighings performed by the supplier. The calculation of the efficiency of the detectors takes into account the anisotropy of the fission fragment emission, using empirical angular distributions. The value of the ^{235}U fission cross section determined by the present measurement is $\sigma_{n,f}(964 \pm 16 \text{ keV}) = 1.20$ barns ± 2.3% (Std. Dev.). The indicated uncertainty in the neutron energy encompasses the kinematic spread of the photoneutron energy distribution. The 2.3% estimate of the error is composed of 1.84% random error and 1.35% systematic error. Each component is a quadrature sum (square root of the sum of the squares of individual error contributions). A detailed analysis of the error sources and propagation is included. (Diss. Abstr. Int., B)

4004 GAMMA SPECTRA OF FISSION PRODUCT MIXTURES. Zappe, D.; Schuricht, V. (Technische Univ., Dresden). Radiochem. Radioanal. Lett.; 15: No. 3, 167-175(20 Oct 1973). (In German).

The methods to measure the γ spectra of fission products are briefly reviewed, and the methods for calculation of the spectra are described. The results are compared with those of other authors on fission products produced by the fission of ^{235}U with thermal neutrons. After a few days of decay, high-energy components (up to 5 MeV) appear in the spectra of the fission products; these have not been previously reported. In most of the cases the spectra of different types of fission differ from each other to a lesser extent than the spectra of the same type of fission reported by different authors. (3 figures) (auth)

4005 UCHENIE O RADIO-AKTIVNOSTI. Istoriya i sovremennost'. (Radioactivity. Past and Present). Kedrov, B. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). 256p.

The discovery of radioactivity and radium and the "newest revolution in science", the discovery of uranium, luminescence, photographic development, gas discharge, x rays, radioactivity of thorium, the discovery of the three new elements polonium, radium and actinium, radioactive isotopes and the neutrino. Developments in the study of radioactivity from Becquerel's discovery of the activity of uranium to rather recent nuclear theories. The work of Pierre and Marie Curie including the early work and the period of great discoveries from 1929-1939 with 515 references are discussed. Also discussed are the work of William Ramsey on radioactivity, the study of radioactivity by Russian scientists (Khlopin, Mendeleev, Fersman and others), the discovery of isotopes, the placement of radioelements in the periodic table, and the genetic relations in radioactive decay, Russian experiments on the synthesis and search of heavy transuranic elements in nature. The work on transuranium elements in the USA including the chemistry on the new isotopes of Einsteinium, Fermium, Mendeleevium and Nobelium, and the results of calculations of the stability of superheavy nuclei, the evolution of the idea of "islands of relative stability" for the elements, the discovery and study of the heptavalent state in neptunium and plutonium, and the practical application of the studies on radioactivity in the search for useful minerals are covered. (SJR)

4006 SPECTRA OF INELASTICALLY SCATTERED NEUTRONS AND THE DENSITY OF NUCLEAR LEVELS. Zhuravlev, B. V.; Kornilov, N. V.; Plyaskin, V. I.; Sal'nikov, O. A. (Physical-Technical Inst., Moscow). pp 219-223 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The energy spectra of neutrons inelastically scattered at 30° by Al, Cu, Nb, Th, and ^{238}U were measured for the incident neutron energy 9.2 ± 0.3 MeV by using time-of-flight techniques. The level density parameters were obtained. (auth)

4007 CROSS SECTION OF THE ^{238}U(n,2n) REACTION AT A NEUTRON ENERGY OF 14.4 MeV AND ITS CONNECTION WITH PROBLEMS OF INTERNATIONAL SAFETY. Darotsi, Sh.; Raich, P.; Chikai, I. (Lajos Kossuth Univ., Debrecen, Hungary). pp 228-232 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The ^{238}U(n,2n)^{237}U reaction was measured at 14.4 MeV by the activation method using a Ge(Li) detector. The cross section was found to be 528 ± 58 mb. The experimental method used renders it possible to give a nondestructive determination of the enrichment ratio in new uranium fuel elements. (auth)

4008 ANGULAR DISTRIBUTION OF FISSION FRAGMENTS OF U AND Th NEAR THE THRESHOLD OF THE (n,2n'f) REACTION. Barutchugil, E.; Yukhas, Sh.; Varnad, M.; Nad, Sh.; Chikai, I. (Lajos Kossuth Univ., Debrecen, Hungary). pp 240-243 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The angular distributions of fragments from neutron induced fission of ^{238}U and ^{232}Th were measured by means of polycarbonate track detectors at the energy $E_n = 14.1$ MeV. The effect of (n,2n'f) threshold was observed. (auth)

4009 ABSOLUTE MEASUREMENT OF α FOR ^{235}U AND ^{239}Pu IN THE NEUTRON ENERGY RANGE FROM 10 keV TO 1 MeV. Kononov, V. N.; Doletaev, E. D.; Prokopets, Yu. S.; Metlev, A. A.; Stavisskii, Yu. Ya. (Physical-Technical Inst, Moscow). pp 293-297 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The ratio of the neutron capture cross section to the fission cross section ($\alpha = \sigma_c/\sigma_f$) for ^{235}U and ^{239}Pu was measured absolutely at neutron energies from 10 keV to 1 MeV by a large cadmium-loaded liquid-scintillator technique. The results of this experiment are in reasonable agreement with other reported values of α, and have accuracy about 10 to 15%. (auth)

4010 STUDY OF THE PARAMETER α FOR ^{239}Pu. Bergman, A. A.; Medvedev, A.N.; Samsonov, A. E.; Stavisskii, Yu. Ya.; Tolstikov, V. A.; Chelnokov, V. B. (Lebedev Inst. of Physics, Moscow). pp 297-301 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The parameter α for ^{239}Pu was measured on the lead slowing-down neutron spectrometer in the energy region $E_n \lesssim 20$ keV. The experimental data were normalized by using measurements with thermal neutrons. (4 figures) (auth)

4011 METHOD FOR THE MEASUREMENT OF THE SIZE OF α. Kononov, V. N.; Poletaev, E. D.; Prokopets, Yu. S.; Metlev, A. A.; Stavisskii, Yu. Ya. (Physical-Technical Inst., Moscow). pp 301-308 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The method of measuring α, the ratio of the neutron capture cross section to the fission cross section, by use of a large liquid scintillator loaded with cadmium and a pulsed Van de Graaff accelerator is described. (auth)

4012 DIRECT MEASUREMENT OF THE RATIO OF THE CAPTURE CROSS SECTION TO THE FISSION CROSS SECTION OF ^{239}Pu IN THE NEUTRON ENERGY RANGE FROM 1 TO 3000 eV. Muradyan, G. V.; Mostovaya, T. A.; Mostovoi, V. I.; Shchepkin, Yu. G. (Inst. of Atomic Energy, Moscow). pp 309-314 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

A method of direct measurement of the capture-to-fission ratio (α) for ^{239}Pu obtained in a neutron energy region of 1 to 3000 eV is described. The fission events are recorded by an ionization chamber. A layer of the substance to be studied is located along the neutron beam and, at the same time, serves as a sample for the capture measurements. Neutron capture is recorded by NaI (Tl) crystals. (2 figures, 1 table) (auth)

4013 MEASUREMENT OF THE RATIO OF THE CAPTURE CROSS SECTION TO THE FISSION CROSS SECTION FOR ^{235}U. Vorotnikov, P. E.; Vukolov, V. A.; Koltypin, E. A.; Molchanov, Yu. D.; Yan'kov, G. B. (Inst. of Atomic Energy, Moscow). pp 314-317 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The neutron capture-to-fission cross-section ratio for ^{235}U was measured for an incident neutron energy range from 5 keV to 50 keV and at 130 keV. The experiment was performed on the pulsed electrostatic accelerator. Neutron energy was measured with the time-of-flight technique. The gamma rays and neutrons from fission events were detected by the stilbene scintillators. The data obtained are tabulated. (1 table) (auth)

4014 MEASUREMENT OF THE SIZE OF ALPHA FOR ^{235}U AND ^{239}Pu IN A NEUTRON BEAM WITH ENERGY OF 2 keV. Dvukhsherstnov, V. G.; Kazanskii, Yu. A.; Furmanov, V. M. (Physical-Technical Inst., Moscow). pp 318-320 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

Alpha values were measured using a neutron beam with energy of 2 ± 0.35 keV. They are 0.49 ± 0.04 for ^{235}U and 1.35 ± 0.09 for ^{239}Pu. (auth)

4015 RADIATIVE CAPTURE OF NEUTRONS BY ^{238}U IN THE ENERGY RANGE FROM 0.024 TO 1.1 MeV. Panitkin, Yu. G.; Stavisskii, Yu. Ya.; Tolstikov, V. A. (Physical Technical Inst., Moscow). pp 321-325 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

Measurements were made of the cross section for radiative capture by ^{238}U in the energy range 0.024 to 1.1 MeV. The gamma radiation was detected by a Ge(Li) semiconductor detector. The results are compared with results of other workers. (auth)

4016 CROSS SECTIONS FOR RADIATIVE CAPTURE AND SOME (n,2n) REACTIONS FOR HEAVY ELEMENTS IN THE NEUTRON SPECTRUM OF THE ACTIVE ZONE OF THE BR-5(UC) REACTOR. Ivanov, V. I.; Markelov, I. P.; Tolstikov, V. A. (Physical Technical Inst., Moscow). pp 325-328 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The radiative ^{238}U capture cross section for the neutron spectrum near the center of BR-5(UC) reactor core was measured. The ratios of the radiative ^{232}Th, ^{237}Np, ^{241}Am, ^{243}Am capture cross sections to the radiative ^{238}U capture cross section were obtained, as well as $\sigma_{n,2n}/\sigma_{n,\gamma}$ ratios for ^{232}Th and ^{237}Np. The experimental results are compared with the calculations. (1 table) (auth)

4017 ENERGY DEPENDENCE OF $\bar{\nu}$ DURING THE FISSION OF ^{238}U WITH FAST NEUTRONS. Savin, M. V.; Khokhlov, Yu. A.; Paramonova, I. N.; Chirkin, V. A. (Inst. of Atomic Energy, Moscow). pp 328-333 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

Results of $\bar{\nu}$ measurements for ^{238}U fission induced by neutrons with energies of 1.3 to 6 MeV are given. The measurements were carried out on a linear electron accelerator by the time-of-flight method (resolution of 1 ns/m) in conjunction with a liquid scintillator. The average $d\bar{\nu}/dE_n$ value for ^{238}U as measured in the present work is $d\bar{\nu}/dE_n = 0.10$ MeV^{-1} for $E_n < 3$ MeV and $d\bar{\nu}/dE_n = 0.18$ MeV^{-1} for $E_n > 3$ MeV. The measured values are accurate to within 1.5 to 3%. (2 figures, 1 table) (auth)

4018 ANGULAR DISTRIBUTIONS OF FRAGMENTS AND CROSS SECTION FOR FISSION OF ^{238}U BY NEUTRONS NEAR THRESHOLD. Vorotnikov, P. E.; Dubrovina, S. M.; Otroshchenko, G. A.; Shigin, V. A. (Inst. of Atomic Energy, Moscow). pp 333-337 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The neutron-induced fission cross section for ^{238}U and angular distribution of fission fragments were measured in the neutron energy interval from 0.5 to 1.5 MeV, with 20 keV energy resolution The cross section has two steps at 1.0 and 1.2 MeV. The changes in the angular distribution of fission fragments are rather strong and seem to be in correlation with the steps in the fission cross section. (2 figures) (auth)

4019 MEASUREMENT OF THE CROSS SECTION FOR FISSION OF ^{238}U BY 2.5-MeV NEUTRONS WITH DEFINITION OF THE NEUTRON BEAM BY THE METHOD OF ASSOCIATED PARTICLES. Kuks, I. M.; Matvienko, V. I.; Nemilov, Yu. A.; Petrzhak, K. A.; Selitskii, Yu. A.; Funshtein, V. B. (Radium Inst., Moscow). pp 337-341 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The method for determination of neutron flux with the help of associated particles was applied to neutrons with an energy of 2.5 MeV produced in the D(d,n)^{3}He reaction. The cross section for ^{238}U fission was found to be 0.55 ± 0.02 barn. (2 figures) (auth)

4020 CHARACTERISTICS OF THE FISSION OF RADIUM. Zhagrov, E. A.; Ippolitov, V. T.; Nemilov, Yu. A.; Selitskii, Yu. A.; Funshtein, V. B. (Radium Inst., Moscow). pp 341-346 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

Results obtained from ^{226}Ra fission by neutrons with energies up to 20 MeV and by γ quanta with endpoint energies of the bremsstrahlung spectrum up to 26 MeV were analyzed. On the basis of measured cross sections and fission fragment angular distributions, fission barriers of ^{225,226,227}Ra were determined, and conclusions were drawn about the structure of energy states at the saddle point. (5 figures) (auth)

4021 MULTILEVEL ANALYSIS OF THE FISSION CROSS SECTION OF ^{239}Pu IN THE RESONANCE REGION. Luk'yanov, A. A. (Physical-Power Inst., Moscow). pp 346-350 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

Parameters of S-Matrix theory for the energy structure of ^{239}Pu fission cross sections below 100 eV are obtained. (1 table) (auth)

4022 INFLUENCE OF THE DOPPLER EFFECT ON THE SHAPE OF RESONANCE LINES. Biryukov, S. A.; Zenkevich, V. S.; Kurilo, V. S.; Moskalev, S. S. (Inst. of Atomic Energy, Moscow). pp 350-354 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The total cross section of plutonium oxide (^{239}PuO$_2$ with ^{240}Pu) was measured on the time-of-flight neutron spectrometer for room and liquid-nitrogen temperatures. The electron linear accelerator of IAE was used as the source of neutrons. The experimental results were compared with Lamb's theory. (auth)

4023 DELAYED NEUTRONS FROM THE SPONTANEOUS FISSION OF ^{252}Cf. Nefedov, V. N.; Mel'nikov, A. K.; Starostov, B. I. (Scientific-Research Inst. of Nuclear Reactors, Moscow). pp 19-29 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The energies, yields, and emission times of some delayed neutron groups were measured by time-of-flight and delayed-coincidence methods. Groups of 0.5-, 0.7-, 1.16-, 1.6-, 2.6-, 1.95-, 2.13-, and 3.3-MeV neutrons were identified. Five values of (2 ∓ 0.5), (7 ∓ 1), (30 ∓ 2), (80 ∓ 5), and (120 ∓ 20) ns were observed for the delayed-neutron emission times. The delayed neutrons make up (3.5 ∓ 0.5)% of the total number of neutrons emitted in ^{252}Cf spontaneous fission. (auth)

4024 ANISOTROPY OF NEUTRON EMISSION AND TOTAL KINETIC ENERGY OF FISSION FRAGMENTS OF ^{252}Cf. Blinov, M. V.; Kazarinov, N. M.; Krisyuk, I. T. (Radium Inst., Leningrad). pp 30-34 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The dependence of the neutron emission anisotropy, A, on the total kinetic energy, E_k, of ^{252}Cf spontaneous fission was investigated. The dependence $A(E_k)$ was also calculated by using the evaporation model. Experimental and calculated data are close at small E_k, but they noticeably diverge at large E_k. That can be due to the presence of neutrons not connected with the evaporation mechanism. (1 figure) (auth)

4025 DEPENDENCE OF THE NUMBER OF NEUTRONS ON THE ENERGY OF α PARTICLES IN THE TERNARY FISSION OF ^{252}Cf. Adamov, V. M.; Drapchinskii, L. V.; Kovalenko, S. S.; Petrzhak, K. A.; Pleskachevskii, L. A.; Tyutyugin, V. G. (Radium Inst., Leningrad). pp 35-39 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The dependence of the neutron number on α-particle energy is studied for the angles 0, 90, and 180° between the directions of motion of the α-particle and the neutron. The difference in numbers of α-particle–neutron coincidences "in" and "against" the direction of α-particle motion is observed. The relative number of neutron–α-particle coincidences at the angles 0 and 180° is found to be 1.17 ± 0.03. The dependence for the angles 90 and 180° was found to be close to that obtained earlier in large-solid-angle experiments. Anomalous dependence for the angle 0° is found. This dependence is supposed to be caused by neutron emission of ^{5}He or ^{6}He particles. The yield of these particles in relation to number of coincidences at the angle 90°, equal to 5.3 ± 0.9%, is determined from the asymmetry value in the number of neutron–α-particle coincidences. (1 figure) (auth)

4026 NEUTRONS FROM THE TERNARY FISSION OF ^{252}Cf. Bochagov, B. A.; Graevskii, A. P.; Kulikov, A. G.; Kupriyanova, L. N. (Ioffe Inst. of Physics and Tech., Leningrad). pp 39–44 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The energy spectra and the ratio of the number of neutrons emitted forward and backward to the α-particle direction were measured by the time-of-flight method for the ternary fission of ^{252}Cf. The contribution from each of fragments to the masses of α particles emitted during this process was estimated by using results of other authors. (auth)

4027 EXPERIMENTAL METHODS FOR THE DETERMINATION OF $\bar{\nu}(^{252}\mathrm{Cf})$. Petrzhak, K. A.; Shlyamin, E. A. (Radium Inst., Leningrad). pp 44–55 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The following absolute methods for measurement of $\bar{\nu}$ of ^{252}Cf are considered: liquid scintillation method, manganese activation method, and $\bar{\nu}(^{252}\mathrm{Cf})$ measurement in the BORON pile. The corrections for the determination of liquid scintillator efficiency and absolute neutron yields on manganese activation are analyzed. The observed disagreement of the order of 2% in the results on the liquid scintillators and manganese bath cannot be explained for the present by the errors of either experiment. The weighted mean of $\bar{\nu}(^{252}\mathrm{Cf})$ is equal to 3.743 ± 0.016. The fitted value by Hanna and Westcott is equal to 3.7653 ± 0.0104. (auth)

4028 INVESTIGATION OF THE REACTION OF RADIATIVE NEUTRON CAPTURE LEADING TO SPONTANEOUS FISSIONING ISOMERS. Gangrskii, Yu. P.; Markov, B. N.; Nad, T.; Kharisov, I. F. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 64–68 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The reaction of radiative capture of neutrons leading to spontaneously fissioning isomers of ^{236}U, ^{242}Am, ^{244}Am, was investigated. The measurements were performed with neutrons of an energy more than 0.5 MeV and with thermal neutrons. The correlation of the processes of isomer formation and induced fission was observed. These results are discussed on the basis of a double-humped barrier model. (2 figures, 1 table) (auth)

4029 ENERGY DEPENDENCE OF THE YIELD OF FISSIONING ISOMERS IN THE REACTION ^{235}U + n. Vorotnikov, P. E.; Otroshchenko, G. A. (Inst. of Atomic Energy, Moscow). pp 69–73 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev, Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The ratio of fission isomer production to prompt-fission yield for ^{235}U + n reaction was measured at 1.05, 0.20, and 0.05 MeV neutron energies. The corresponding isomer ratios were calculated and found to be markedly higher than typical ones obtained in the experiments with charged particles. The results are compared with other authors' data. (3 figures, 1 table) (auth)

4030 EFFECT OF THE EXCITATION ENERGY OF FISSIONING NUCLEI ON THE YIELDS AND KINETIC ENERGIES OF THE FRAGMENTS. Sergachev, A. I.; Tarasko, M. Z.; D'yachenko, P. P.; Kuz'minov, B. D. (Physical-Power Inst., Moscow). pp 74–78 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The energy dependence of fragment yields and kinetic energies for neutron-induced fission of ^{233}U, ^{235}U, ^{238}Pu, and ^{239}Pu below 15 MeV was studied. (4 figures) (auth)

4031 FINE STRUCTURE IN THE MASS DISTRIBUTION OF FISSION FRAGMENTS. Korstylev, V. A.; Ryazanov, D. K.; Safonov, V. A. (Scientific-Research Inst. of Atomic Reactors, Moscow). pp 78–84 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The yields of the neutrons and γ rays in mass fraction distribution of ^{235}U thermal fission were measured for fine structure. The correlation between neutron and fragment mass yield was observed. The neutron yield for fragment mass 132 was close to zero. (4 figures) (auth)

4032 MEASUREMENT OF THE AVERAGE KINETIC ENERGIES OF THE FRAGMENTS OF THE FISSIONING NUCLEI ^{238}Pu, ^{239}Pu, AND ^{240}Pu. Nikolaev, V. A. (Radium Inst., Kiev). pp 85–90 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The average kinetic energies of fragments of the fissioning nuclei ^{238}Pu, ^{239}Pu, and ^{240}Pu, obtained from the fission of ^{238}Pu and ^{239}Pu by neutrons and ^{238}Pu spontaneous fission, were measured by means of glass detectors with Al filters. A discrepancy in the tendency for the average kinetic energy to increase as a function of the parameter $Z^2/A^{1/3}$ was observed in the case of the fissioning nucleus ^{238}Pu. (1 table) (auth)

4033 PROMPT NEUTRONS AND KINETIC ENERGY OF THE FRAGMENTS FROM SPONTANEOUS FISSION OF ^{244}Cm. Alhazov, I. D.; Kovalenko, S. S.; Kostochkin, O. I.; Malkin, L. Z.; Petrzhak, K. A.; Shpakov, V. I. (Radium Inst., Leningrad). pp 90–96 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The total number of prompt neutrons as a function of the kinetic energy of fragments was measured for spontaneous fission of ^{244}Cm. Contour graphs were obtained for the distribution of the mean number of prompt neutrons per fission event, ν, for the separate modes of fission determined by the total kinetic energy, E_k, and the mass of one of the fragments, M, and for the distribution of fission event number in the same coordinates. From these data, the dependences of ν on M and E_k, and the dependence of excitation energy necessary for the emission of neutrons on M (which are on the whole analogous to the dependences for spontaneous fission of ^{252}Cf), were calculated. The average value of fragment excitation energy necessary for the emission of a neutron is determined to be 7.2 MeV. The mass dependence for the total prompt energy release in ^{244}Cm spontaneous fission was plotted. The independence of mass distribution of ν and the contraction of E_k distributions are noted for a fixed ratio of mass and ν. (2 figures) (auth)

4034 VARIATION OF THE MULTIPLICITY OF THE GAMMA QUANTA DURING FISSION OF ^{235}U BY RESONANCE NEUTRONS. Borukhovich, G. Z. (Ioffe Inst. of Physics and Tech., Leningrad); Petrov, G. A.; Teterev, E. N.; Panteleev, Ts.; Ryabov, Yu, V.; Tyan San Khak pp 97–101 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The gamma-ray multiplicity variations were measured for ^{235}U resonant fission by using the fast pulsed reactor IBR (the energy resolution of the spectrometer was 0.22 μs/m). The method of $(f-\gamma-\gamma)$ coincidences was used for γ rays with energies of 0.4 to 2 MeV. For two possible compound systems with the spins (3^-) and (4^-), the following relative difference for $(f-\gamma-\gamma)$ yields was obtained: $\eta_{\mathrm{exp}} = (1.4 \pm 0.8)\%$. By assuming the fission fragment γ-ray yields to be independent of the compound nucleus spin, it is possible to say that the mean width difference for the $(n, \gamma f)$ process in ^{235}U fission $(I^\pi = 3^-$ and $4^-)$ is not more than 2 MeV. (1 table) (auth)

4035 MEASUREMENT OF THE POLARIZATION OF FISSION GAMMA RAYS. Val'skii, G. V.; Pleva, Yu. S. (Ioffe Inst. of Physics and Tech., Leningrad). pp 101–108 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The linear polarization coefficient of the γ rays in slow neutron fission of ^{235}U was measured by using a Compton polarimeter. The measurements were performed for γ rays emitted at an angle of 90° to the fission axis. The electrical vector $\vec{E}$ was found to be parallel to this axis. The average value of the polarization coefficient was ~0.15. The γ-ray energy dependence of this coefficient was approximately the same as that for the γ-ray angular anisotropy coefficient. It is concluded that E2 transitions are prevalent in the fission fragment de-excitation process. (1 figure) (auth)

4036 X-RAY EMISSION DURING THE THERMAL FISSION OF URANIUM-235. Popeko, L. A.; Petrov, G. A.; Kochubei, E. F.; Zvezdkina, T. K. (Ioffe Inst. of Physics and Tech., Leningrad). pp 108-113 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The properties of x rays associated with the thermal fission of ^{235}U were studied by using the multiparameter method. The energy resolution of the x-ray semiconductor detector was about 0.8 keV for the 13.86-keV line of ^{241}Am. From these measurements the authors obtained the x-ray intensity distributions as a function of the charges and masses of the fission fragments for the following total kinetic energy intervals: (150–163), (163–171), and (171–210) MeV. As a result of the calculations the most probable mass numbers and x-ray yields were obtained for definite fragment charges. (1 table) (auth)

4037 FORMATION OF LIGHT NUCLEI IN THE TERNARY FISSION OF URANIUM ISOTOPES WITH THERMAL NEUTRONS. Vorob'ev, A. A.; Grachev, V. T.; Zalite, Yu. K.; Kondurov, I. A.; Nikitin, A. M.; Seliverstov, D. M.; Smirnov, N. N. (Ioffe Inst. of Physics and Tech., Leningrad). pp 113-118 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

Yields and energy spectra of H, He, Li, Be, B, and C isotopes from ternary fission were determined for ^{234}U and ^{236}U. The data were analyzed by using a fast scission model. (3 figures, 1 table) (auth)

4038 GENETIC RELATION OF THE RADIATION OF DELAYED NEUTRONS AND THE FISSION PROCESS. Maksyutenko, B. P. (Physical-Power Inst., Moscow). pp 118-123 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The connection of radiation of delayed neutrons and the fission process was studied, and from the relative yields of the delayed neutrons the distribution was established for ^{235}U thermal fission. This method can be applied for studying the change of this distribution with energy. (2 figures, 1 table) (auth)

4039 DELAYED NEUTRONS AND THE PHYSICS OF FISSION. Maksyutenko, B. P. (Physical-Power Inst., Moscow). pp 123-127 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

For the first time, by the process of peeling of the decay curves of delayed neutrons, the relative yields of the main part of the pure precursors were established; these were in good agreement with radiochemical data. This method can be applied to studying the change of these parameters with energy. (2 figures, 1 table) (auth)

4040 EVALUATION OF THE CROSS SECTION FOR RADIATIVE CAPTURE OF NEUTRONS BY THORIUM-232. Davletshin, A. N.; Tolstikov, V. A.; Abramov, A. I. (Physical-Power Inst., Moscow). pp 166-170 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

Experimental data on radiative neutron capture cross sections in the energy range above 10 keV for ^{232}Th nuclei are considered, and evaluation of averaged cross sections is performed. (1 figure) (auth)

4041 REEVALUATION OF THE CROSS SECTION FOR RADIATIVE CAPTURE OF FAST NEUTRONS BY URANIUM-238. Abramov, A. I.; Tolstikov, V. A. (Physical-Power Inst., Moscow). pp 170-175 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

Reevaluation of data on radiative neutron capture cross sections for ^{238}U is carried out with the results of recent experiments and evaluation taken into account. (2 figures) (auth)

Nuclear Theory

Refer also to abstracts 3608, 3627, 3637, 3682, 3798, 3810, and 4392.

4042 (BNL-50387, pp 5-28) RESONANCE REACTION FORMALISMS FOR FISSILE NUCLEI. de Saussure, G. (Oak Ridge National Lab., TN). Apr 1973.

From meeting of the Resonance Region Subcommittee of CSEWG; Upton, New York, USA (8 May 1972).

In multi-level effects in reactor calculations and the probability table method.

The multilevel formalisms that have been most frequently used to represent the cross sections of the fissile isotopes are briefly discussed, and a review is given of how these formalisms can all be derived from the Wigner–Eisenbud R-matrix theory. Some of the properties of the resonance parameters entering the various multilevel formalisms are described, and some applications of these formalisms are discussed. (LBS)

4043 (BNL-50387, pp 31-37) NEW HOPE AND WHY BOTHER. Moore, M. S. (Los Alamos Scientific Lab., NM). Apr 1973.

From meeting of the Resonance Region Subcommittee of CSEWG; Upton, New York, USA (8 May 1972).

In multi-level effects in reactor calculations and the probability table method.

The importance of new data on spins and fission-channel quantum numbers for resolved resonances of fissile targets is pointed out. It is noted that such data will help to resolve problems of nonunique multilevel descriptions. (LBS)

4044 (COO-3235-29) ISOSCALAR TRANSITION DENSITIES OF ISOVECTOR EXCITATIONS. Goulard, B.; Deal, T. J.; Fallieros, S. (Montreal Univ., Quebec (Canada). Lab. de Physique Nucleaire; Brown Univ., Providence, R. I. (USA). Dept. of Physics). 1973. Contract AT(11-1)-3235. 8p. Dep. NTIS $3.00.

An energy-weighted sum rule is written down containing both isoscalar and isovector transition densities. As an application, a previously obtained expression for the isoscalar transition density of a dipole state is rederived. (auth)

4045 (JINR-D6-7094) 13th SYMPOSIUM ON NUCLEAR SPECTROSCOPY AND NUCLEAR THEORY, DUBNA, JUNE 19-23, 1973. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 192p. (In Russian and English). (CONF-730645-). Dep. NTIS (U. S. Sales Only) $11.75.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

The collection includes the theses of the reports submitted to the symposium, which cover the newest results of the theoretical and experimental investigations on the structure of the atomic nucleus. Series of reports are devoted to the problems concerned with the technique of obtaining and mathematical by processing spectrometric data. (auth)

For title listings of individual papers see: 2755–2761, 2800, 3349, 3708, 3709, 3753–3758, 3780–3782, 3803–3808, 3833–3852, 3896–3917, 3947–3959, 3984, and 4046–4060.

4046 (JINR-D6-7094, pp 17-18) MICROSCOPIC APPROACH TO THE DESCRIPTION OF THE PROPERTIES OF TRANSITION NUCLEI. Dzholos, R. V.; Denau, F.; Kartavenko, V. G.; Yanssen, D. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4047 (JINR-D6-7094, pp 19-20) DESCRIPTION OF THE INELASTIC SCATTERING OF NUCLEONS WITH EXCITATION OF THE ROTATIONAL STATES OF THE NUCLEUS. Krutov, V. A.; Sorokin, A. I. (Leningrad State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4048 (JINR-D6-7094, pp 21-22) CALCULATION OF THE CONTRIBUTION OF THE ROTATION OF THE NUCLEUS TO THE OPTICAL POTENTIAL. Sorokin, A. I. (Leningrad State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4049 (JINR-D6-7094, pp 23-24) DESCRIPTION OF THE SCATTERING OF NUCLEONS ON EVEN–EVEN DEFORMED NUCLEI BY MODIFIED COUPLED-CHANNELS METHOD. Knyaz'kov, O. M. (Leningrad State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4050 (JINR-D6-7094, pp 31-32) COUPLING BETWEEN THE INTERNAL WAVE FUNCTIONS IN DIFFERENT REPRESENTATIONS. Voikhanskii, M. E.; Listengarten, M. A.; Feresin, A. P. (Leningrad State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4051 (JINR-D6-7094, p 33) EVALUATION OF THE SIZE OF THE CHARGE DISTRIBUTION OF NUCLEI IN ELECTRON CAPTURE. Suslov, Yu. P.; Danilenko, V. N. (Leningrad State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4052 (JINR-D6-7094, pp 34-35) ANGULAR CORRELATIONS OF L ELECTRONS IN ee, γe, AND eγ CASCADES DURING E0 CONVERSION. Listengarten, M. A. (Leningrad State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4053 (JINR-D6-7094, pp 36-37) NATURE OF THE HIGHLY EXCITED STATES IN INTERMEDIATE AND HEAVY SPHERICAL NUCLEI. Zhivopistsev, F. A.; Lukashev, A. V.; Shitikova, K. V. (Moscow State Univ.). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4054 (JINR-D6-7094, pp 38-39) MICROSCOPIC THEORY OF THE PREEQUILIBRIUM DECAY IN INTERMEDIATE AND HEAVY NUCLEI. Zhivopistsev, F. A.; Lukashev, A. V.; Shitikova, K. V. (Moscow State Univ). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4055 (JINR-D6-7094, p 42) INFLUENCE OF NONCOLLECTIVE STATES ON THE TWO-PHONON TRIPLET IN VIBRATIONAL NUCLEI. Reinhardt, H.; Doenau, F. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4056 (JINR-D6-7094, pp 43-44) EXPLANATION FOR THE CORIOLIS FORCE ATTENUATION. May, F. R.; Frauendorf, S.; Muenchow, L. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4057 (JINR-D6-7094, p 50) CORIOLIS ANTIPAIRING EFFECT (CAP) IN HIGH SPIN ROTATIONAL STATES. Frauendorf, S. (Joint Inst. for Nuclear Research, Dubna, USSR); May, F. R.; Muenchow, L. 1973.

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4058 (JINR-D6-7094, pp 184-185) SIGN OF THE INTERACTION ENERGY OF QUADRUPOLE AND OCTUPOLE OSCILLATIONS IN EVEN–EVEN DEFORMED NUCLEI. Begzhanov, R. B.; Belen'kii, V. M.; Usharov, V. K. (Inst. of Nuclear Physics, Tashkent). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4059 (JINR-D6-7094, pp 188-189) COLLECTIVE E1 TRANSITION OPERATOR IN DEFORMED NUCLEI. Begzhanov, R. B.; Belen'kii, V. M.; Usharov, V. K. (Inst. of Nuclear Physics, Tashkent). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4060 (JINR-D6-7094, p 191) E0 TRANSITIONS AND BETA VIBRATIONAL 0^+ STATES IN EVEN–EVEN DEFORMED NUCLEI. Birbrair, B. L.; Voinova, N. A.; Smirnova, N. S. (Leningrad Inst. of Nuclear Physics). 1973. (In Russian).

From 13th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (19 Jun 1973).

4061 (JINR-P2-7211) MULTIPARTICLE CORRELATIONS IN MULTIPLE PRODUCTION PROCESSES. Kopylov, G. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The correlations between three or four like pions were calculated. The aim is to explain the effects seen previously (similar to the GGLP-effect), and to develop the method of obtaining the space-time picture of multiple production processes. The effect is expressed in terms of a b_{ij}-mutual coherence function of like pions. It can be calculated for the pions independently generated by randomly distributed oscillators. A formula gives the correlations between like pions where D_s (b_{ij}) is the permutant (determinant with pluses only) of mutual coherence functions. The explicit formulas for 3 or 4 pions are given. The correlations between like fermions are derived. This permits one to measure the form and the mean life of highly excited nuclei that can evaporate many neutrons. The conditions of observing the effect in terms of variables $\omega_i - \omega_j$, $\bar{p}_i - \bar{p}_j$ are briefly analyzed. (auth)

4062 (JINR-P4-7269) EFFECT OF THE MOLECULAR STRUCTURE ON THE ATOMIC AND NUCLEAR MESON CAPTURE. Ponomarev, L. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 67p. (In Russian). Dep. NTIS (U. S. Sales Only) $5.50.

Basic experimental data are presented on the detection and study of the effect of chemical structure of substance on the meson capture. The representations which are used at present for the analysis of the results of these experiments are also given. (auth)

4063 (JINR-P4-7312) REACTIONS OF COMPLETE NUCLEUS FUSION. Kalinkin, B. N.; Permyakov, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973, 62p. (In Russian). Dep. NTIS (U. S. Sales Only) $5.25.

There were considered the main results of theoretical works on the problem of complex nucleus fusion and separation (in this process) of the reaction of production of thermodynamical equilibrium compound nucleus. (auth)

4064 (JINR-P4-7374) INTERACTION OF TWO-QUASIPARTICLE AND PHONON EXCITATIONS IN EVEN–EVEN NUCLEI. Vdovin, A. I.; Kyrchev, G.; Stoyanov, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A possibility of describing the interaction of two-quasiparticle and phonon excitations in even–even nuclei in the framework of the semi-microscopic approach is considered. It is shown that this interaction essentially affects the structure of excited 1.5-2.5-MeV states in deformed and some spherical nuclei. Formulas are derived for the state energies and the wave function coefficients. (auth)

4065 (JINR-P4-7425) POSSIBILITIES IN CALCULATIONS OF STRIPPING FORM FACTORS. Bang, E.; Bunakov, V. E.; Gareev, F. A.; Shul'ts, G.; Yamaleev, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 34p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

Approximate equations for stripping form factors are derived in perturbation theory. The expansion into a set of Sturmian functions is suggested for the form factors, thus partly justifying the well-depth prescription procedure. Numerical calculations are carried out. The asymptotic behavior of the form factors is discussed. (auth)

4066 (KFKI-73-40) BETA-DECAY IN OPTICAL ISOMERS. Hrasko, P. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

The connection between optical purity of living matter and parity violation in beta-decay is discussed. A simple model called helical electron gas is proposed for the description of electrons inside an optically active medium. Beta-decay probability of a nucleus embedded into such medium is calculated. (auth)

4067 (LA-tr-73-43) LONG RANGE DEVELOPMENTS IN NUCLEAR PHYSICS. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Aug 1973. Translation by A. D. Cernicek of Developpement a Long Terme de la Physique Nucleaire (Excerpt). 67p. Dep. NTIS $5.50.

This report is a translation of part of a longer document entitled "Long-Range Developments in Nuclear Physics". It appears to be part of the justification for conversion of the ALS to a superconducting machine with a 100% duty cycle. The scope of the present document (sections IV, V, and part of VI in the original) can be indicated by listing its headings and subheadings. Nuclear physics with intermediate-energy hadrons is subdivided as follows: generalizations (meson effects, nuclear structure at high momentum), study of nucleon–nucleon interaction, elastic scattering, inelastic scattering, ejection of fragments, pion production reactions (study of mechanisms, nuclear spectroscopy, various studies), and production of K and physics of hyperfragments. Nuclear physics with intermediate-energy photons and electrons is subdivided as follows: generalization concerning physics of electromagnetic interactions, elastic and inelastic scattering of electrons with high transfer (electron elastic scattering, electron inelastic scattering, studies of higher excitation modes, form factor of nucleon and deuteron), ejection reactions with electrons (generalities, reaction (e,e′p) in quasi-free kinematics, other reactions), photonuclear reaction in the Δ(1236) resonance region (physics of the Δ(1236) baryon resonance as an elementary particle, interaction of the Δ_{33} with nuclear matter, meson effects in photonuclear reactions, measurement of the momentum distribution of neutrons in nuclei, study of time reversal invariance in electromagnetic interactions, comparison with electronuclear reactions), photofission and electrofisson at high energy (general remarks, study of photofission ($40 \text{ MeV} < E_\gamma < 600 \text{ MeV}$), study of fission fragment spectra, angular distribution of fission fragments, study of electrofission), and photonuclear reactions below threshold of pion photoproduction (general remarks, experiments at high energy resolution, utilization of polarized monochromatic photons, coincidence experiments). Sections on pion and kaon physics are as follows: scattering reactions, mesic atoms (π- and K-mesic atoms, μ-mesic atoms), pion and muon capture (study of collective vibrations of the giant resonance type by capture of pions and muons, nonradiative capture of pions and muons), and various applications (electrodynamics, solid physics and mesochemistry); this section cuts off in mid-sentence. It should be noted that this report is a rough draft and does not contain a final polished translation: the French word "moment" can mean "moment, momentum, impulse", and often the wrong choice is made. Another possible cause of confusion is the use of 2p–2t instead of 2p–2h for 2-particle–2-hole configurations. (RWR)

4068 (ORNL-TM-4347) NEW GIANT RESONANCES IN NUCLEI. An Interim Review. Satchler, G. R. (Oak Ridge National Lab., Tenn). Sep 1973. Contract W-7405-eng-26. 44p. Dep. NTIS $4.25.

The recent identification of a giant quadrupole resonance, just below the giant dipole, has led to considerable interest in resonances higher than the dipole. Some theoretical background is given first: the effects of shell structure on the spectrum for 1-hole and 1-particle–1-hole states, sum rules, effective charges, selection rules and the distribution of excitation strength, and the interaction model for inelastic scattering are considered. The experimental evidence from electron and hadron inelastic scattering is then presented, and the paper ends with a discussion of indirect evidence of giant resonances. (20 figures, 1 table, 42 references) (RWR)

4069 (ORNL-tr-2734) FORMATION AND DECAY OF COMPOUND NUCLEI IN HEAVY-ION-INDUCED REACTIONS. Barashenkov, V. S.; Zheregi, F. G.; Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. Translation of JINR-P7-7165. 41p. Dep. NTIS $4.25.

A statistical model of heavy-ion nuclear reactions, passing through compound nucleus formation and decay, is considered. Competition of the fission and evaporation processes is discussed. The accuracy is estimated, and the boundaries of statistical model applicability are clarified by comparison with experimental values. Further development of statistical theory demands more detailed consideration of the process of heavy ion fusion and taking into account of the dependence of the fission barriers and the density level parameters on the excitation energy and other characteristics of decaying nuclei. The contributions of noncompound processes must also be considered. (auth)

4070 (ORO-4317-28) COMPRESSIBILITY IN NUCLEAR COLLECTIVE DYNAMICS. Griffin, J. J.; Kan, K. K. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Aug 1973. 15p. (SM-174/58). Dep. NTIS $3.00.

Thesis. Submitted by K. K. Kan.

Because of the fact that the energy of nuclear matter increases very rapidly with changes in density, the nucleus as a fluid is generally assumed to be incompressible. It is proposed that this assumption is valid only on the average. It is shown that to impose it as a microscopic identity is inconsistent with a realistic description of finite nuclei, and precludes the consideration of certain phenomena which may play an essential role in collective dynamics. (auth)

4071 (ORO-4317-29) RELATIVISTIC SINGLE-PARTICLE POTENTIALS FOR NUCLEI. Technical Report 74-017. Miller, L. D. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Aug 1973. 34p. Dep. NTIS $3.75.

The Dirac equation with general interactions of scalar, pseudoscalar, vector, pseudovector, and tensor type is investigated as the appropriate wave equation for the description of single-nucleon motion inside nuclei. The consequences of requiring the single-particle Hamiltonian to commute with the total angular momentum, parity, and time reversal operators are obtained. It is found that time reversal invariance and hermiticity do not lead to equivalent restrictions for one component of the relativistic interaction as they do for all local nonrelativistic potentials. Various ways of introducing a strong spin-orbit force, as is observed in physical nuclei, are proposed. All models with strong spin-orbit forces are shown to lead to large relativistic corrections to the single-particle magnetic moments which invalidate the Schmidt estimates unless the relativistic interaction for which time-reversal invariance and hermiticity are nonequivalent restrictions is included. The time-reversal invariant (antihermitean) form of this interaction is shown to produce a real eigenvalue spectrum. One is forced to introduce a degree of state-dependence in the single-particle potentials in order to insure probability current conservation. (auth)

4072 (UJF-3027-F) CALCULATION OF THE COMPOUND NUCLEUS CROSS-SECTION USING THE HAUSER–FESHBACH THEORY. Burjan, V. (Ustav Jaderne Fyziky, Rez (Czechoslovakia)). Jul 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

The program for the calculation of the total and differential cross sections for the nuclear reactions of the particles with the spin 0, $\frac{1}{2}$, and 1 using the Hauser–Feshbach theory of the compound nucleus was compiled for use on the Gier computer. Transmission coefficients for incoming and outgoing channels are fed from the input tape. All possible outgoing channels are described by a level density formula. (auth)

4073 NEW APPLICATIONS OF HARTREE–FOCK CALCULATIONS TO NUCLEI WITH $20 < A < 60$. Lee, H. C. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 20-50 of Fifth Symposium on the Structure of Low-Medium Mass Nuclei. Davidson, J. P. (ed.). Lexington, KY; University Press of Kentucky (1973).

From 5th symposium on the structure of low medium mass nuclei; Lexington, Kentucky, USA (26 Oct 1972). See CONF-721066-.

A review is given of the deformed projected Hartree–Fock calculations which use spherical harmonic oscillator wave functions as a basis and a density-independent two-body nucleon–nucleon interaction. Structural calculations are presented for magnesium-24, sodium-22, magnesium-25, and iron-56. Also, nonstructural calculations are given for the neutron halo in neutron-rich nuclei and the mirror asymmetry in allowed beta decays. In these nonstructural calculations the effects due to the charge asymmetry in the electromagnetic interaction are studied. Light and medium nuclei are discussed. (JFP)

4074 SYSTEMATICS OF NUCLEAR SINGLE-PARTICLE STATES. II. The Region $A < 35$. Malaguti, F.; Hodgson, P. E. (Nuclear Physics Lab., Oxford). Nucl. Phys.; A215: No. 2, 243-252(1973).

The energies of single-particle states in nuclei with $A < 35$ are obtained as eigenvalues of a local Saxon-Woods potential with depth depending linearly on A and on the nuclear symmetry parameter. (auth)

4075 QUASIFREE TWO-BODY MODEL FOR NUCLEAR π-ABSORPTION. Nyman, E. M. (NORDITA, Copenhagen). Nucl. Phys.; A215: No. 2, 397-410(1973).

The energies and angular correlations of pairs of nucleons emitted in the capture of atomic π^- mesons are determined in a simple two-body model. Special emphasis is put on the dependence of these quantities on the nuclear species. Although the capture is assumed to proceed through a two-nucleon mechanism, no detailed knowledge of the nuclear correlations is needed. The capture into other final states is briefly discussed. (auth)

4076 AXIAL ASYMMETRY AND MASS ASYMMETRY AT THE SCISSION POINT. Schultheis, H.; Schultheis, R. (Univ., Munich). Nucl. Phys.; A215: No. 2, 329-348(1973).

In order to study the influence of deviations from axial symmetry on the potential energy at scission, the usual two-spheroid scission configuration has been extended to tri-axial ellipsoids. The (controversial) adiabatic assumption has been avoided by adjusting all β-values to experimental data. Numerical results are given for twenty mass divisions of ^{236}U. Although it is found that the effect of non-axial deformations on the potential energy strongly depends on the mass asymmetry of the nucleus a non-axial shape is energetically favored in only one fission mode. Even in this case, the energy gain due to deviations from axial symmetry is small. Thus the assumption of axial symmetry in previous quasi-static calculations of kinetic and excitation energies of the fragments is justified. Fission fragments at scission can be classified as soft or stiff according to their stiffness against γ-deformation. From this it follows that non-axial deformations in necked-in nuclei should be described by two independent shape parameters, one for each fragment. (auth)

4077 BINDING ENERGY AND COMPRESSIBILITY CALCULATIONS FOR INFINITE NUCLEAR MATTER. Khanna, K. M.; Barhai, P. K. (Birla Inst. of Tech., Ranchi, India). Nucl. Phys.; A215: No. 2, 349-365(1973).

An attempt is made to determine an effective interaction having no hard core, and to give the correct binding energy and density of nuclear matter, consistent with good estimates of nuclear matter parameters in calculations of the Hartree-Fock type. The failure of Volkov-type potentials to give saturation in nuclear matter was studied in detail. Two effective interactions, which consist of a Volkov-type part and a density-dependent part, were constructed. These interactions, parametrized by a fit to the binding energy and density of nuclear matter, are found to give reasonable values for compressibility. The energy versus density relations obtained with our interactions have been compared with that of Skyrme. (auth)

4078 POLARIZATION EFFECTS IN THE EQUATION OF STATE FOR NEUTRON STAR MATTER. Kaellman, C. G. (Institutionen foer Fysik, Porthansgatan, Finland). Nucl. Phys.; A213: No. 3, 461-468(1973).

A new method is given for calculating the equation of state for dense neutron matter taking into consideration the polarization of the medium around a quasiparticle within Landau's theory of normal Fermi liquids. It is found that polarization effects make the matter more incompressible. (auth)

4079 MANY-BODY MODIFIED LIPPMANN–SCHWINGER EQUATIONS FOR COULOMB-LIKE POTENTIALS. Prugovecki, E.; Zorbas, J. (Univ. of Toronto). Nucl. Phys.; A213: No. 3, 541-569(1973).

It is shown that when long-range potentials are present the wave functions for each channel are the solutions of certain homogenous integral equations. These equations imply that the wave functions do not satisfy the Lippmann-Schwinger equations. However, the same wave functions also satisfy inhomogeneous integral equations involving an operator $Z^{(a)}$. This operator guarantees the existence of channel wave operators as strong limits of modified time evolution operators. An explicit integral representation for this operator is presented and it is shown that it displays ultraviolet divergencies at large relative velocities of the fragments whenever these fragments interact via Coulomb-like potentials. In case that long-range forces are absent $Z^{(a)} = 1$ and the inhomogeneous integral equations reduce to the Lippmann-Schwinger equations for the wave function. Also a general method for relating the wave functions for Coulomb-like potentials to the solutions of the Lippmann-Schwinger equations for screened Coulomb-like potentials is presented. (auth)

4080 NILSSON ORBITS FOR A PARTICLE IN A WOODS–SAXON POTENTIAL WITH Y_2^0 AND Y_4^0 DEFORMATIONS, AND COUPLED TO CORE ROTATIONAL STATES. Hird, B. (Univ. of Ottawa). Comput. Phys. Commun.; 6: No. 1, 30-37(Jul 1973).

The computer program NILSSON ORBITS written in FORTRAN IV for the IBM 360/65 computer is described for obtaining the eigenvalues and expansion coefficients of a single nucleon in an axially symmetric potential for any quadrupole and hexadecapole deformations. The central part of the potential is assumed to have a Woods–Saxon shape, with the derivative of this shape for the spin-orbit and the deformed parts. The rotational excitations of the core are added to the particle states together with all the rotation-particle Coriolis terms to generate the band mixed collective excited state spectrum of a deformed odd A nucleus. (JFP)

4081 DESCRIPTION OF YRAST LEVELS IN SPHERICAL NUCLEI WITH AN EXACTLY SOLVABLE MODEL. Krumlinde, J.; Kaijser, A. (Lund Inst. of Tech., Sweden). Lett. Nuovo Cim.; 8: No. 11, 669-674(10 Nov 1973).

A model consisting of Ω degenerate $(N = 1)$-oscillator shells with a pairing and a quadrupole interaction between the particles is used along with group-theoretical methods to describe the yrast sequence for nearly closed shell and transitional nuclei. (LBS)

4082 COMPOUND CONTRIBUTIONS TO NUCLEAR REACTIONS INVOLVING THE ANALOG RESONANCE. Agassi, D.; Vagar, Z. (Weizmann Inst. of Science, Rehovot, Israel). Phys. Lett.; 46B: No. 2, 160-162(17 Sep 1973).

A treatment of the compound nucleus decay in the vicinity of the analog state which does not invoke the Hauser–Feshbach formula is given. Comparison with experimental data proves qualitative agreement of the energy dependence of excitation curves. (auth)

4083 POSSIBILITY OF EMPLOYING THE SHADOW EFFECT FOR STUDYING THE DECAY OF QUASI-STATIONARY STATES. Eremin, N. V.; Melikov, Yu. V.; Tulinov, A. F. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 65: No. 3, 875-878(Sep 1973). (In Russian).

It is suggested that the shadow effect, which is observed in nuclear reactions in single crystals, be employed for studying the effect of nonuniform population of an isolated quasi-stationary state on its decay. It is shown that displacement of a compound nucleus from the crystal lattice site has a stronger effect on the shape of the shadow in the case of partial population of the state, than in the case of uniform population. (auth)

4084 REARRANGEMENT ENERGIES IN GOUND–STATE CALCULATIONS. Kümmel, H. (Institut für Theoretische Physik, Ruhr–Universität Bochum, West Germany). Phys. Rev. C 8: No. 3, 1144-1145 (Sept 1973).

The occurrence of rearrangement terms in the self–consistent potential of ground–state calculations depends critically on the order in which approximations and variation of the energy expectation value are performed. (auth)

4085 EFFECT OF FINE STRUCTURE ON NUCLEON TRANSFER TO ANALOG STATES. Vincent, C.M. (University of Pittsburgh, Pittsburgh, Pennsylvania 15213); Fortune, H.T. Phys. Rev. C 8: No. 3, 1084-1090 (Sept 1973).

We extend our previous distorted–wave Born–approximation treatment of reactions of the form A(d, p)B (in which B is an unbound state) to include the case where B is (a) dissolved into a fine structure of resonances that may overlap strongly, and (b) unstable against emission of other particles in addition to the transferred particle n. We assume that the reaction is strongly peripheral and goes through the n + A channel of B via the np interaction. We discuss the cross section for an experiment in which only particle p is detected, while the decay products of B are not observed or identified. For an isobaric–analog resonance we find that the cross section is proportional to $\Gamma_n \cos 2(\delta_N + \phi)$, where Γ_n is the n escape width, δ_N is the nuclear background phase shift, and ϕ is the asymmetry phase. The cross section is entirely determined by the gross–structure parameters of the resonance, and does not depend on the nature of the fine structure. For the reaction ^{92}Mo(d, n) to $d_{5/2}$ (8.40-MeV), $s_{1/2}$ (9.33-MeV), and $d_{3/2}$ (9.91-MeV) analog states, we find that the effect of $\delta_N + \phi$ is negligible. (auth)

4086 NEW EXPRESSION FOR THE MOMENT–OF–INERTIA PARAMETER. Ullah, N.; Sandhya Devi, K. R. (Tata Institute of Fundamental Research, Bombay-5, India). Phys. Rev. C 8: No. 3, 1167-1168 (Sept 1973).

A new expression for the moment–of–inertia parameter has been derived using the method of moments. The relation between the present expression and the Skyrme expression is given and its implications are discussed. (auth)

4087 DEFINITION OF THE NUCLEON–NUCLEUS OPTICAL POTENTIAL BY MEANS OF THE LOW EQUATION. Ernst, D.J.; Shakin, C.M.; Thaler, R.M. (Physics Department, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. C 8: No. 3, 855-858 (Sept 1973).

The Low equation, generalized to the case of an energy–dependent potential, is used to define a nucleon–nucleus optical potential. Although this approach is completely equivalent to previous definitions of the optical potential for nucleon–nucleus scattering, it should be easier to adapt this treatment to relativistic, field–theoretic problems. (auth)

4088 HAUSER–FESHBACH THEORY AND ERICSON FLUCTUATIONS IN THE PRESENCE OF DIRECT REACTIONS. Engelbrecht, C.A.; Weidenmüller, H.A. (Institut für Theoretische Physik der Universität, and Max–Planck–Institut für Kernphysik, Heidelberg, Germany). Phys. Rev. C 8: No. 3, 859-862 (Sept 1973).

Neglecting level–level correlations, we show that consistency conditions derived from general properties of the S matrix determine the distribution of resonance parameters. This is also true in the presence of direct reactions. Formulas are given for average cross sections, autocorrelation, and cross–correlation functions. (auth)

4089 RECOIL EFFECTS IN SINGLE–NUCLEON–TRANSFER HEAVY–ION REACTIONS. DeVries, R.M. (Département de Physique Nucléaire á Moyenne Energie, Centre d'Etudes Nucléaire de Saclay, 91190 Gif sur Yvette, France). Phys. Rev. C 8: No. 3, 951-960 (Sept 1973).

The effect of recoil in single–nucleon–transfer heavy–ion reactions is found to be twofold: Extra transfer angular momenta are introduced and the radial integrals are changed. Comparison of an exact recoil distorted-wave Born-approximation program with experimental data from heavy-ion reactions induced on ^{11}B and ^{12}C gives excellent quantitative agreement. Recoil effects on other targets and energies are considered. (auth)

4090 "INACCESSIBLE REGIONS" IN CONSTRAINED HARTREE-FOCK CALCULATIONS. Bassichis, W.H. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550); Tuerpe, D.R. Phys. Rev. C 8: No. 3, 1146-1148 (Sept 1973).

Although a modified constrained Hartree-Fock procedure has been presented which permits calculations in "inaccessible regions" a misconception has limited its acceptance. The idea underlying this misconception, namely, a relation between energy and single-particle energies, is discussed and is shown, both algebraically and numerically, to be invalid. (auth)

4091 THE EFFECT OF VIBRATIONAL CORRELATIONS ON THE MOMENT OF INERTIA IN A GENERALIZED SKYRME-LEVINSON MODEL. Gupta, K.K.; Ullah, N. (Tata Institute of Fundamental Research, Bombay, India); Rowe, D.J. Phys. Rev. C 8: No. 3, 1154-1157 (Sept 1973).

The Skyrme-Levinson model for rotations and the oscillator-projection method for vibrations are combined to give a generalized Skyrme-Levinson model in which rotations and vibrations are treated together on an equal basis. Expressions are given for the moment of inertia and the ground-state energy of a vibrational deformed nucleus. They are applied to the prolate and oblate Hartree-Fock solutions for ^{28}Si. (auth)

4092 THEORY OF GROUND STATE CORRELATIONS OF CLOSED SHELL NUCLEI: A DENSITY-MATRIX FORMULATION. Franz Krejs; Klein, A. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). J. Math. Phys. (N.Y.) 14: No. 9, 1155-1163 (Sept 1973).

A general theory of long range correlations in the ground state of a closed shell nucleus is outlined, using a number of ideas introduced or adumbrated, but not always successfully developed, in previous work of the authors and others. These include the following: (i) Any operator can be formally expressed as a series in particle-hole (p-h) excitation and destruction operators which should converge rapidly for a suitable choice of single-particle basis at the closed shells. By means of these relations and with the help of sum rules all observables can be computed without the explicit use of wave functions. (ii) For a fixed choice of single-particle basis, the ground state energy can be computed from a variational principle in which in lowest nontrivial approximation, in consequence of (i), the parameters are amplitudes of the same type as occur in the random phase approximation (RPA). The precise relation to RPA is fully detailed. (iii) The single particle basis chosen is the natural orbital basis of Lowdin, which presents itself as the obvious choice both for formulation of the dynamics and for the algorithm of solution. (iv) Though the theory deals with pairs of fermion operators, particular attention is paid that all Pauli principle restrictions are satisfied. (v) It is verified that in the perturbation limit, known results are reproduced. The method is generally applicable to any system for which the correlations can be viewed as particle-hole excitations with respect to a reference Slater determinant. (auth)

4093 EFFECT OF THE Δ RESONANCE ON THE PROPERTIES OF NUCLEAR MATTER. Osadchiev, V. M.; Troitskii, M. A. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 18: No. 3, 501-507(Sep 1973). (In Russian).

Effect of the Δ resonance on characteristics of the nuclear matter was estimated. The correction to the binding energy is -2 MeV. (auth)

4094 SHELL-MODEL APPROACH TO DESCRIPTION OF NUCLEON-NUCLEUS ELASTIC SCATTERING. Zaretskii, D. F.; Urin, M. G. (Moscow Engineering-Physics Inst.). Yadern. Fiz.; 18: No. 3, 508-518(Sep 1973). (In Russian).

Description of low-energy nucleon-nucleus elastic scattering based on the shell-model approach to the theory of nuclear reactions is presented. The expression obtained for the S matrix is, in general, different from that predicted by the optical model. Difference between the two approaches is considered concretely for strength functions of slow neutrons. (auth)

4095 SOME ASPECTS OF ATOMIC EFFECTS IN NUCLEAR TRANSITIONS. Crasemann, B. (Univ. of Oregon, Eugene). Nucl. Instrum. Methods; 112: No. 1-2, 33-39(1973).

The influence of atomic electrons on nuclear decay modes is reviewed, including some higher-order processes, and modifications of decay rates due to environmental effects are briefly considered. (6 figures, 74 references) (auth)

4096 COUPLED-CHANNEL APPROACH TO BARYON RESONANCES IN NUCLEI. Jena, S. Pittsburgh; Carnegie-Mellon Univ. (1973). 132p. University Microfilms Order No. 73-22,869. Thesis (Ph. D.).

A nonrelativistic coupled-channel formalism is constructed to take into account the excitation of baryon resonances in nuclei, and thus the baryon-resonance components are introduced explicitly into the nuclear wave function. The coupling potentials are computed in the static field theoretic one-pion exchange limit. The wave functions for the excited $\Delta(1236)-\Delta(1236)$ configuration in the deuteron are calculated in a coupled-channel Lippmann-Schwinger formalism. It is shown that, though in general the admixture of the $\Delta-\Delta$ configuration is very small, these components can give dominant contribution to the scattering cross sections in the high momentum transfer processes. This is due to the strong peaking of the baryon-resonance wave functions in a range of momenta where N-N configurations are essentially negligible. A coupled-channel K-matrix formalism is used to compute the inelastic effects on the N-N scattering phase shifts due to the virtual excitation of the baryon resonances in the intermediate states. It is shown that these inelastic contributions can account for most of the intermediate range attraction in N-N force, which is attributed to the hypothetical scalar mesons in the usual one-boson-exchange models. (Diss. Abstr. Int., B)

4097 HALFWAY-PLANE AND CONTINUUM CALCULATIONS OF BLOCKING DIPS FOR DISPLACED ATOMS. Tachibana, K. (Nagoya Univ., Japan). Radiat. Eff.; 19: No. 2, 135-137(Jun 1973).

It is stated that for such studies as the location of impurity atoms, lattice disorder, or the lifetime of a nuclear reaction, using the channeling technique, it is important to know how the displacement of an atom from the atomic row affects the characteristic of the channeling profile. The results are presented of a comparison between the halfway-plane model (Lindhard, Mat. Fys. Medd. Dan. Vid. Selsk; 34:No. 14 (1965)) and the simple analytical treatment of the so-called continuum approximation for the yield of particles emitted from an atom off the lattice site. It is concluded that the continuum model can predict the displacement of the atom with reasonable accuracy if the displacement is not as large as r_0 (the radius of the unit cell of the channel). (UK)

4098 SEMICLASSICAL TREATMENT OF HEAVY ION ELASTIC SCATTERING. Morsy, M. W.; Toepffer, C. (Univ., Frankfurt am Main). Z. Phys.; 263: No. 3, 227-250(1973).

A generalized semiclassical treatment for the elastic scattering of heavy ions is developed in the presence of a complex optical potential. The scattering phase shift and its derivatives with respect to the impact parameter are calculated after extending the JWKBL approximation. The results are compared with experimental data for the elastic scattering of ^{16}O from medium and heavy target nuclei and, a relation between the present treatment and that of the optical model and Regge pole analysis is established. (orig.) (GE)

4099 FIFTH SYMPOSIUM ON THE STRUCTURE OF LOW-MEDIUM MASS NUCLEI. Conference Held at Lexington, Kentucky, October 26-28, 1972. Davidson, J. P.; Kern, B. D. (eds.). Lexington, KY; University Press of Kentucky (1973). 311p. (CONF-721066-). $12.50.

From fifth symposium on the structure of low medium mass nuclei; Lexington, Kentucky, USA (27 Oct 1972).

Fourteen papers are included; separate abstracts are prepared for thirteen. One paper was previously abstracted for NSA and appeared as 27:29159. (LBS)

For abstracts of individual papers see: 3717-3720, 3766-3770, 3785, 3810, 3862, and 4073.

4100 NUCLEON WIDTHS OF LEVELS IN THE SHELL MODEL AND THE COUPLED-CHANNEL METHOD WITH STRONG COUPLING. Yadrovskii, E. L.; Niledvin, S. D.; Grishanova, S. I.; Titarenko, N. N. (Moscow State Univ.). pp 55-59 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The three methods of calculating nucleon widths are compared: the method of reduced widths (R-matrix theory), the shell-model approach of the unified theory, and the coupled-channels method. (2 tables) (auth)

4101 PARAMETRIZATION SCHEME FOR NUCLEAR CROSS SECTIONS WITH ALLOWANCE FOR CHANNEL COUPLING. Luk'yanov, A. A. (Moscow State Univ.). pp 59-65 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The channel-coupling scheme for parametrization of cross sections is derived from R-matrix theory. Direct interactions and compound processes are taken into account. (auth)

4102 SPECTRA AND ANGULAR DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS. Shubin, Yu. N.; Stavinskii, V. S. (Moscow State Univ.). pp 72-75 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The results of statistical-theory calculations of the inelastic neutron scattering spectra and angular distributions are presented at incident neutron kinetic energies of 8 and 14 MeV. The evaluation of every angular momentum contribution was performed. The results show that there exists a small anisotropy in the angular distributions. It is pointed out that calculated spectra differ from the Maxwellian ones and also from very often used approximate forms. This should be taken into account when the direct process contribution is evaluated. (3 figures) (auth)

4103 EXCITATION OF DOORWAY STATES IN REACTIONS WITH NEUTRONS. Kolomiets, V. M. (Inst. of Nuclear Studies, Kiev). pp 75-85 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The possibility of excitation of intermediate structure and doorway states in (n,n) and (n,γ) reactions is discussed. (3 tables) (auth)

4104 MODEL OF DOORWAY STATES IN THE THEORY OF NUCLEAR REACTIONS. Drozdov, S. I. (Inst. of Atomic Energy, Moscow). pp 85-89 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The review of the phenomenological many-body theory of nuclear reactions is presented in the form of MacDonald. The mechanism of reactions is described by the model of the doorway states. (auth)

4105 EFFECT OF THE SHELL STRUCTURE OF SINGLE-PARTICLE SPECTRA ON THE BEHAVIOR OF RADIATIVE WIDTHS. Ignatyuk, A. V. (Moscow State Univ.). pp 89-94 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The calculations of the average radiative width of highly excited nuclei on the basis of the superfluid-nucleus model are discussed. The account of selection rules for the single-particle transition operator strongly influence the form of the spectrum and the energy dependence of the radiative width. (auth)

4106 STATISTICAL DESCRIPTION OF THE SPECTRA OF INELASTICALLY SCATTERED NEUTRONS. Dovbenko, A. G.; Ignatyuk, A. V. (Moscow State Univ.). pp 94-99 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The influence of the nuclear level density on the results of calculations of the spectra of neutrons evaporated from the compound nucleus are discussed. (auth)

4107 ANALYSIS OF THE (n,α) REACTION IN THE FRAMEWORK OF THE OPTICAL MODEL. Furman, V. I.; Popov, Yu. P. (Joint Inst. for Nuclear Research, Dubna USSR). pp 159-164 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The study of the (n,α) reaction gives valuable information about total and partial α widths for many nuclei. The analysis of these results in the framework of the optical model permits comparison and systematization of α widths for all isotopes under investigation. As there is no phenomenological optical potential, a theoretical one was used. The relevant parameters are listed. By special choice of the imaginary part of the optical potential, satisfactory agreement between experimental and calculated total average α widths and appropriate strength functions was achieved. (3 figures, 3 tables) (auth)

4108 LONG-RANGE CORRELATIONS IN SPACINGS BETWEEN NEUTRON LEVELS AS POSSIBLE RESULT OF THE CORRELATIONS OF SINGLE-PARTICLE NUCLEI. Sukhoruchkin, S. I. (Inst. of Theoretical and Experimental Physics, Moscow). pp 189-200 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

From the analysis of experimental data on the positions of excited nuclear levels conclusions can be drawn on the existence of the stabilizing effect of nuclear shells. (6 figures) (auth)

4109 DEVIATION OF THE DISTRIBUTION OF γ LINES ACCORDING TO ENERGY FROM STATISTICAL PREDICTIONS. Sumbaev, O. I.; Smirnov, A. I.; Kondurova, L. N. (Ioffe Inst. of Physics and Tech., Leningrad). pp 201-206 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

It was found that the energies of soft ($50 \leq E \leq 600$ keV) intense γ lines in the complex (n,γ) spectra from odd–odd spherical nuclei (^{46}Sc, ^{60}Co, ^{76}As, ^{94}Nb, ^{104}Rh, ^{116}In, ^{140}La, ^{142}Pr, and ^{198}Au), measured with precise spectrometers, are more likely to coincide with A_k/m, where A_k are A/3, A/2, 2A/3, A, 4A/3, 3A/2, 5A/3, 2A, m is some integer, and A is 1021.2 ± 2.2 keV. An attempt was made to explain the proximity of A to $2\ m_ec^2$ by the influence of the atomic electron shells on the γ-ray intensities; however, the appropriate cross sections proved to be too small to explain the effect. (3 figures, 1 table) (auth)

4110 STUDY OF THE MECHANISM OF THE INELASTIC SCATTERING OF 14-MeV NEUTRONS ON LIGHT AND INTERMEDIATE NUCLEI. Zeliger, D.; Zeidel, K.; Vol'fart, D. (Technical Univ., Dresden). pp 243-252 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

In addition to the equilibrium statistical model, the paper deals with the application of the nonequilibrium statistical model of Griffin to describe correctly the Raman spectrum within a wide energy range and to obtain information on the mechanism of the inelastic scattering process. (7 figures) (auth)

4111 ENERGY AND ISOTOPIC SPIN DEPENDENCE OF THE OPTICAL POTENTIAL FROM DATA ON NEUTRON SCATTERING. Pasechnik, M. V.; Korzh, I. A.; Kashuba, I. E. (Inst. of Nuclear Research, Kiev). pp 253-261 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The results of an optical-model analysis of data on elastic scattering of polarized and unpolarized neutrons from nuclei in a large mass range ($48 < A < 137$) at four neutron energies in the range 1.5 to 6.1 MeV are presented. (3 figures, 2 tables) (auth)

4112 SOME NEW RESULTS IN THE THEORY OF FISSION. Strutinskii, V. M. (Inst. of Nuclear Research, Kiev). pp 3-18 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

New results in theory of nuclear fission based on the shell correction approach are briefly described. A comparison with empirical data is given. (11 figures, 1 table) (auth)

4113 CHARACTERISTICS OF PHASE TRANSITIONS DURING THE FISSION OF HEAVY NUCLEI. Vorotnikov, P. E. (Inst. of Atomic Energy, Moscow). pp 56-64 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The results of the channel analysis of heavy-nucleus fission at low energies are given. The data obtained do not correspond to the traditional understanding of the potential barrier penetrability, but they have a natural explanation assuming the dependence of fission on the phase transition in a nucleus at ~8 MeV. (8 figures) (auth)

4114 SOME QUESTIONS ON THE CONTEMPORARY THEORY OF THE NUCLEUS. Davydov, A. S. (Inst. of Theoretical Physics, Kiev). pp 295-304 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

A review of theoretical articles is given in which the properties of atomic nuclei are investigated on the basis of the data on nucleon–nucleon interactions. (auth)

4115 DIFFRACTION NUCLEAR PROCESSES. Sitenko, A. G. (Inst. of Theoretical Physics, Kiev). pp 305-317 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

Experimental data on hadron–nucleon scattering show that the hadron–nucleon interaction has a diffractive nature. The scattering of hadrons by nuclei at high energies can therefore, be described by analogy to an optical diffraction; i.e., it can be considered as a multifold diffraction scattering by separate nucleons. The diffraction approach allows the hadron–nucleus interaction amplitude to be expressed through the amplitude of scattering by separate nucleons and the form factors depending on the nuclear structure. Diffraction theory is in good agreement with numerous experimental data on the scattering of pions and nucleons by deuterium and other light nuclei, and at present can serve as a basis for extracting information about nuclear structure and the hadron–nucleon interaction from experimental data on the hadron–nucleus interaction. (1 figure) (auth)

4116 EXCITATION OF NUCLEI BY PARTICLES OF NEAR BARRIER ENERGIES. Luk'yanov, V. K.; Titov, A. I. (Joint Inst. of Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 2, 306-315(Aug 1973). (In Russian).

A quasiclassical variant of the coupled-channel method is used to investigate the excitation of nuclei with energies near the Coulomb barrier. The excitation probability for low-lying collective states is found to be quite sensitive to variations of parameters of the nuclear potentials and to the probabilities of electromagnetic transitions. Comparison with the perturbative calculations and with available experimental data is carried out. (auth)

4117 DISTRIBUTION OF PARTICLE-HOLE STATES. Nemirovskii, P. E.; Manevich, L. G. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 18: No. 2, 295-305(Aug 1973). (In Russian).

Moment and energy distributions of the particle-hole states are considered for deformed and spherical nuclei in framework of the model of the degenerate Fermi gas with the one-particle spectrum cut off at the binding energy. A correction accounting for the pair correlated interactions between the fermions is introduced. For nuclei with a closed shell where the Fermi gas spectrum is not applicable in view of the shell structure a possibility was considered to use a sum of the Gaussian distributions. The pairing effect in this case was also taken into account. The calculated results are compared with the data on the particle-hole states that may be obtained from the experimental information on the level distribution. (auth)

4118 SHELL CORRECTIONS TO NUCLEAR MASSES IN PRESENCE OF PAIRING. Kolomiets, V. M. (Inst. of Nuclear Research, Kiev). Yadern. Fiz.; 18: No. 2, 288-294(Aug 1973). (In Russian).

Features of calculations of the shell corrections to the nuclear masses with inclusion of pairing forces are considered in the Bogolyubov–Hartree–Fock approximation. It is shown that a simple thermodynamical interpretation may be attributed to the calculation of the first-order shell correction. (auth)

4119 INDUCED β–γ CORRELATION OF THE DIRECTIONS FOR ALLOWED β TRANSITIONS. Denisenko, G. A.; Khaimovich, E. P. (Physical-Technical Inst., Kazan). JETP Lett. (USSR) (Engl. Transl.); 17: No. 12, 463-465(20 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 12, 667-669(20 Jun 1973).

A new type of β–γ direction correlation, which appears only in the presence of definite perturbations, is considered. This effect can be used to determine the characteristics of the excited states of nuclei and to detect acoustic nuclear resonance. (auth)

4120 GROUP-THEORETICAL METHOD FOR CALCULATING OVERLAPS OF HFB STATES. Becker, H. G. (Univ., Bonn). Z. Naturforsch.; 28a: No. 7, 1049-1055(1973). (In German).

Overlaps of Hartree–Fock–Bogoljubov states occurring in modified HFB theories (e.g., projected HFB) are calculated using group theoretical methods. For this purpose the Bogoliubov–Valatin transformation is generalized. The resulting nonunitary transformation leaves the Fermi commutation relations invariant, but the characteristic property of the creation and annihilation operators, namely that they are hermitean conjugate to each other, is lost. A suitable factorization of the new transformation is derived, which also applies to the unitary Bogoliubov–Valatin transformation but the structure of which is completely different from the well known Bloch–Messiah decomposition. Furthermore, the relation between various representations of the HFB state vector is clarified. (GE)

4121 ANALYSIS OF FORMATION OF THE SUPPRESSION EFFECT OF NUCLEAR REACTION. Inelastic Channels in the Presence of Hyperfine Splitting. Kagen, Yu.; Afanas'ev, A. M. (Inst. of Atomic Energy, Moscow). Z. Naturforsch.; 28a: No. 8, 1351-1360(1973).

The analysis carried out of the emergence of the effect of suppression of the nuclear reaction (ES) during resonance Bragg scattering of Moessbauer gamma-quanta from nuclei under the conditions of a hyperfine splitting allows one to clearly reveal the fundamental features characteristic of this phenomenon. In a general case of realization of ES neither electric nor magnetic vectors of the wave field in the crystal turn to zero at the points of equilibrium positions of the nuclei. For the reaction to be suppressed, it is necessary that the total amplitude of the excited nucleus formation be zero. In this case, there is a rather peculiar picture of the electromagnetic field within the crystal sets which depends on the character of the hyperfine splitting and on the multiplicity of the transition. (GE)

4122 INNER COULOMB CORRECTIONS TO PION–NUCLEUS SCATTERING. Faeldt, G. (Univ. of Lund, Sweden); Pilkuhn, H. Phys. Lett., 46B: No. 3, 337-340(1 Oct 1973).

A semiclassical model for inner Coulomb corrections to pion-nucleus scattering in the Δ-resonance region is suggested. Its main consequence is a change of the nuclear radius R, giving $R(\pi^-)/R(\pi^+) = 1 + 2Z\alpha E/k^2 R$. The Glauber model can be extended to include these effects. (auth)

4123 PENETRATION OF A TWO-BUMP POTENTIAL BARRIER. Tyapin, A. S.; Marshalkin, V. E. Yadern. Fiz.; 18: No, 2, 277-282(Aug 1973). (In Russian).

An analytical expression is obtained for calculation of the penetrance for two-bump barrier with a prominent well between the bumps. In the deep subbarrier region it coincides with the corresponding expression of previous work but besides it is valid in the threshold region. The resonance structure on the penetration curve near the threshold exists, but is essentially less evident than in the deep underbarrier region. The imaginary part of the fission potential influences the penetration curve in the threshold region in a substantially other way, than deep under the barrier. The barrier factor for potentials with nonzero imaginary part is close to one at very high energies only. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

4124 SIXTH EUROPEAN CONFERENCE ON CONTROLLED FUSION AND PLASMA PHYSICS. Volume I. Contributed Papers. Conference Held at Moscow, USSR, July 30–August 4, 1973. Dubna, USSR; Joint Institute for Nuclear Research (1973). 689p. (CONF-730705-P1).

Separate abstracts were prepared for 148 of the included papers. Abstracts of the three remaining papers have appeared previously in NSA as 28: 11946, 14164, and 14189. (MOW)

For abstracts of individual papers see: 4138–4191, 4194–4198, 4208, 4209, 4217–4221, 4229–4247, 4251–4258, 4271–4297, 4310–4323, and 4340–4353.

4125 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 7, No. 9, 1973. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 54p.

Confinement and Heating

Refer also to abstracts 4244, 4246, 4258, 4259, and 4285.

4126 (LRP-64/73) LINEAR RF TURBULENT HEATING EXPERIMENT. Skarsgard, H. M. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Jun 1973. 19p. Dep. NTIS (U.S. Sales Only) $3.00.

It is considered how one might change the rf experiment to try to produce hot, turbulent plasmas and also the feasibility of investigating the turbulence using the (CO_2) laser scattering technique. (auth)

4127 ELECTRON CYCLOTRON HEATING AS INVERSE CYCLOTRON RADIATION. Shohet, J.L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 8, 1375-1376 (Aug 1973).

Microwave heating of a plasma is developed as an inverse emission process. Heating rates based on this theory show close agreement with those based on particle motion or conductivity. Thus, well-known emission theories provide a basis for determining heating rates. (auth)

4128 STEADY-STATE SOLUTIONS FOR RELATIVISTICALLY STRONG ELECTROMAGNETIC WAVES IN PLASMAS. Max, C.E. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 8, 1277-1288 (Aug 1973).

New steady-state solutions are derived which describe electromagnetic waves strong enough to make plasma ions and electrons relativistic. A two-fluid model is used throughout. The following solutions are studied: (1) Linearly polarized waves with phase velocity much greater than c; (2) arbitrarily polarized waves with phase velocity near c, in a cold uniform plasma; (3) circularly polarized waves in a uniform plasma characterized by a scalar pressure tensor. All of these waves are capable of propagating in normally overdense plasmas, due to nonlinearities introduced by relativisitic effects. The propagation of relativistically strong waves in a density gradient is examined, for the example of a circularly polarized wave strong enough to make electrons but not ions relativistic. It is shown that such a wave propagates at constant energy flux despite the nonlinearity of the system. However, nonlinear effects can greatly increase the maximum plasma density at which a relativistically strong wave can propagate. Applications to laser-plasma interactions and to pulsar environments are discussed. (auth)

4129 EFFECT OF THE PLASMA DENSITY PROFILE ON ION-CYCLOTRON WAVE GENERATION. Hosea, J.C.; Sinclair, R.M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 8, 1268-1272 (Aug 1973).

It is shown that the loading of a Stix coil by ion-cyclotron wave production in plasma, which exhibits a second maximum previously reported to be anomalous, can be explained in detail by taking into account the plasma density profile. Data from a number of experiments show that the efficiency for heating the plasma by wave absorption is a monotonically increasing function of density. The reduced heating efficiency observed at the second loading maximum relative to the first can be attributed to damping of the waves responsible for the second maximum in the lower density surface region of the plasma column. (auth)

4130 RADIAL PARTICLE LOSS IN A HIGHLY IONIZED CYLINDRICAL PLASMA COLUMN. Chung, K.; Huang, K.C.; Levi, E. (Polytechnic Institute of Brooklyn, Farmingdale, New York 11735). Phys. Fluids 16: No. 8, 1245-1251 (Aug 1973).

The statistical properties of the plasma fluctuations in a long plasma column produced by a hollow cathode arc discharge show that different states of weak plasma turbulence exist. The transition between these states occurs as a result of changes in the confining magnetic field, the background gas pressure, and the boundary conditions. Associated with such transitions are radical changes in the plasma confinement. A sudden jump in the radial particle loss rates is manifested by the increase of the current collected by Buchelnikova ring-collectors and by the change in the radial density profiles measured by electrostatic probes. (auth)

4131 EFFECT OF FIELD ERRORS ON PLASMA CONFINEMENT IN THE DC OCTOPOLE. Yoshikawa, M. (Gulf General Atomic, Inc., San Diego, CA); Gilleland, J. R.; Ohkawa, T.; Tamano, T.; Meade, D. M. J. Phys. Soc. Jap.; 34: No. 6, 1600-1610(Jun 1973).

The effect of field errors on plasma confinement is studied in the dc octopole. These studies were conducted at very low densities, when the mean free path is greater than the characteristic machine dimensions. Both classical diffusion and electron–neutral scattering are negligible because of the low densities and high magnetic fields employed in the measurements. The axisymmetric error field of a few percent does not affect the confinement time. The axially asymmetric error field of a small fraction of a percent reduces the confinement time substantially. The dependence of the confinement time on the octopole and the error field, the ion mass, and the electron temperature is studied. The results indicate that the plasma loss in the dc octopole is due to the flow along the flux lines which spiral out of the confinement volume in presence of the error field. (auth)

4132 CHARACTERISTICS OF STATIONARY AND START-UP HEATING OF A D-T FUSION REACTOR BY MEANS OF FAST-NEUTRAL-BEAM INJECTION. Ohnishi, M.; Yoshikawa, H.; Wakabayashi, J. (Kyoto Univ.). Nucl. Fusion; 13: No. 5, 761-763(Oct 1973).

Thermal instability of a D–T reactor is studied by making use of the static characteristics between the ion temperature and the injection beam energy, and the stable, unstable, and self-sustaining regions are obtained in the $n\tau - T_i$ diagram. The dynamic behavior of plasma temperature is also studied numerically; the results are consistent with the static analysis. (MOW)

4133 HIGH-β PLASMA BEHAVIOR IN A CANTED MIRROR. Dandl, R. A.; Eason, H. O.; England, A. C.; Sprott, J. C. (Oak Ridge National Lab., TN). Nucl. Fusion; 13: No. 5, 693-701(Oct 1973).

A high-β hot-electron plasma was studied in an asymmetric magnetic mirror device with a variable cant angle. The plasma was produced by microwave heating at a frequency corresponding to cold-electron-cyclotron resonance together with a higher frequency suitable for upper-off-resonance heating. The position of the high-β plasma annulus was studied as a function of cant angle and was found to correspond approximately to the position of a midplane modulus-B contour. High-β effects did modify the spatial location of the losses of energetic electrons into the loss cone but had little effect on the cold-plasma losses. Destabilization was not observed when the line-tying of the plasma center was reduced with glass end plates. An asymmetry of the cold-plasma loss with respect to the equatorial plane was observed at small cant angles and an electric field model was conjectured to explain this behavior. (auth)

4134 BOOTSTRAP EQUILIBRIA IN TOKAMAKS WITH NEUTRAL INJECTION, INCLUDING THE ENERGY BALANCE. Sigmar, D. J.; Rutherford, P. H. (Princeton Univ., NJ). Nucl. Fusion; 13: No. 5, 677-683(Oct 1973).

The radial profiles of density, temperature, and current of an axisymmetric toroidal plasma in the banana regime are calculated for the case where the rotational transform is produced by a seed current and the radial heat losses are balanced by a heat source. The seed current and heat source are localized in a finite region around the magnetic axis. (auth)

4135 COLLISIONLESS SHOCK WAVES IN PLASMAS. Biskamp, D. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 13: No. 5, 719-740(Oct 1973).

Recent developments in collisionless-shock-wave research are reviewed. Theoretical concepts are compared with both numerical simulation results and experimental observations. Particular emphasis is put on the analysis of collisionless dissipation processes, anomalous resistivity, and viscosity. (auth)

4136 ANOMALOUSLY CONFINED TOKAMAK REACTOR. Horton, W. Jr. (Univ. of Texas, Austin); Kammash, T. Nucl. Fusion; 13: No. 5, 753-755(Oct 1973).

The implication of the wide range of possible plasma behavior on fusion reactor design and performance is examined. The thermal stability of such a system is also studied by solving the underlying dynamic equations. It is shown that, for a low-beta tokamak-type reactor, anomalous diffusion characterizing drift-wave turbulence is especially desirable since it provides a self-regulating mechanism consistent with steady-state operation. (MOW)

4137 ADIABATIC GAMMA FOR TWO-DIMENSIONAL COMPRESSION OF AN UNSTABLE PLASMA. Krall, N. A. (Univ. of Maryland, College Park); Hamasaki, S. J. Geophys. Res.; 78: No. 13, 2337-2340(1 May 1973).

A study was made of the adiabatic two-dimensional compression of a collisionless magnetized plasma with the idea of deducing the value of γ (as in pV^{γ} = constant) appropriate for such a two-dimensional compression when the effect of instabilities is included (without instability, of course, $\gamma = 2$). The increase in temperature parallel to background magnetic field is calculated for a plasma in which the temperature, perpendicular to the field, is forced to increase at a constant rate (as by "2-d" compression), whistler instabilities providing the only coupling between parallel and perpendicular temperature. This establishes a relation between T_{perp} and $T_{parallel}$ that is maintained in any slow perpendicular compression of this system, and this relation can be used to deduce the adiabatic constant γ. The method was used to interpret measurements made aboard a Nike-Tomahawk sounding rocket during auroral breakup at a time corresponding to a burst in light and electron intensity and was interpreted to be a magnetic compression of the plasma. (MCW)

4138 BEHAVIOR OF IONS IN THE TOKAMAK-4 PLASMA. Gorgunov, E. P.; Zaverzhaev, V. S.; Petrov, M. P. (Inst. of Atomic Energy, Moscow). pp 1-4 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The ion temperature was determined from an energy analysis of charge-exchange atoms. The measurements were carried out in the stationary stage of a discharge near the current maximum. The experiment was conducted in order to determine when the ions would pass from the plateau region into the collisionless banana region. It was found that impurities leading to an increased effective ion–ion collision frequency did not allow the ions to reach the banana region. (MOW)

4139 CLEO TOKAMAK EXPERIMENT. Paul, J. W. M.; Gibson, A.; Hugill, J.; Land, J.; Reynolds, P.; Stott, P. E. (Culham Lab., Abingdon, Eng.). pp 5-8 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The apparatus and its operation as a tokamak suitable for neutral injection are described. Pulses of 100 ms with 80 kA were achieved with conductivity temperatures of 130 eV and spectroscopic temperatures of 200 to 400 eV. (auth)

4140 CONFINEMENT OF AN ANOMALOUSLY HEATED PLASMA IN A TOKAMAK (TTF). Martone, M. (EURATOM-CNEN, Rome). pp 10-13 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Fast-current diffusion ($\tau < 1$ μsec) in a pre-ionized H_2 plasma (4.5 mtorr) and plasma heating ($\beta_p = 0.4$) were observed in a tokamak-like experiment ($R = 30$ cm, $a = 4$ cm, $B_T = 6.2$ kG, $I_p = 7.6$ kA). A theoretical analysis of the current diffusion, including ohmic heating, gives an increase of the resistivity during the current-diffusion phase by a factor ~60 with respect to the Spitzer value. After the current diffusion (heating) phase, the plasma current, decoupled from the energy source, decays in a time that depends on the toroidal magnetic field strength. (auth)

4141 CURRENT AND PRESSURE DISTRIBUTIONS IN THE HIGH-β TOKAMAK EXPERIMENT TEE. Noll, P.; Korten, M.; Kugler, E.; Sand, F.; Waelbroeck, F.; Waldmann, G. (Kernforschungsanlage, Juelich, Ger.). pp 14-17 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Some parameters deduced from poloidal magnetic field profiles obtained in TEE shortly after the fast compression and from equilibrium relations are discussed. In contrast to the screw pinch, these plasmas of lower density are surrounded by a "vacuum" ($\nabla \times B \approx 0$) magnetic field configuration. (auth)

4142 NEOCLASSICAL TRANSPORT PHENOMENA IN A TOKAMAK. Daybelge, U. (Ruhr Univ., Bochum, Ger.). pp 25-28 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The distribution function was found from the drift kinetic equation in order to calculate the neoclassical transport coefficients. The solutions are based on exact Fokker–Planck collision terms and a singular perturbation analysis in the phase space. The results deviate from the ones obtained using model operators or variational techniques. (auth)

4143 EFFECT OF MAGNETIC FIELD IRREGULARITIES ON PLASMA DIFFUSION. Casati, G. (CNR, Milan); Dobrowolny, M.; Lazzaro, E.; Orefice, A. pp 33-36 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The particle collisional diffusion in toroidal plasmas with small, space-dependent magnetic field perturbations superimposed on an axisymmetric magnetic field is analyzed. (auth)

4144 EFFECT OF NONAXISYMMETRY ON THE TRANSPORT COEFFICIENTS OF A TOROIDALLY CONFINED PLASMA. Varma, R. K.; Sen, A. (Physical Research Lab., Ahmedabad, India). pp 37-40 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The effect of magnetic field ripples on the particle transport for toroidally confined plasmas is calculated. The Vlasov equation is solved for the nonaxisymmetric perturbations over the axisymmetric state, which is taken to be a function of the constants of motion. The diffusion coefficient obtained is found to be proportional to the fraction of the magnetic energy in the ripple and also has geometric factors that could make it significant. (auth)

4145 EQUILIBRIUM AND ENERGY BALANCE IN TOKAMAKS. Dnestrovskii, Y. N.; Kostomarov, D. P.; Karetkina, N. V.; Pavlova, N. L.; Popov, A. M. (Moscow State Univ.). pp 41-44 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Plasma equilibrium in a torus in the presence of an external magnetic field and a conducting shell with finite conductivity was studied by numerical methods. The problems associated with the injection of a hot neutral beam and the resulting plasma heating are discussed. The banana regime role in tokamaks is also briefly discussed. (MOW)

4146 NEUTRAL INJECTION ON THE CLEO TOKAMAK. Sheffield, J.; Aldcroft, D.; Burcham, J.; Cole, H. C.; Cowlin, M.; Speth, E.; Stott, P. E. (Culham Lab., Abingdon, Eng.). pp 51-54 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Neutral hydrogen beams of 50 kW power were injected into plasmas produced by 200 kW of ohmic heating. The beam trapping efficiency is ~70%. Fast ions ($E_i < E_{i0}$) are detected, thus power is transferred to the plasma. No ill effects are observed. An improved system, delivering 100 kW of neutrals, was installed. (auth)

4147 INVESTIGATION OF HF PLASMA HEATING AND OF PLASMA BEHAVIOR IN THE TM-3 TOKAMAK. Alikaev, V. V.; Arsen'ev, Yu. I.; Bobrovskii, G. A.; Poznyak, V. I.; Razumova, K. A.; Sokolov, Yu. A. (Inst. of Atomic Energy, Moscow). pp 63-66 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The additional heating by means of high-power hf radiation which is made resonant at the low hybrid frequency was investigated. (auth)

4148 ORMAK AND NEUTRAL INJECTION. Barnett, C. F.; Berry, L. A.; Bush, C. E.; Callen, J. D.; Clarke, J. F.; Colchin,

R. J.; Dory, R. A.; England, A. C.; Hogan, J. T.; Kelley, G. G.; McNally, J. R. Jr.; Murakami, M.; Neidigh, R. V.; Roberts, M. (Oak Ridge National Lab., TN). pp 67-70 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The plasma conditions attained in the ohmically heated ORMAK experiment provide a satisfactory base for neutral-injection heating. Plasma flows and radial electric fields of the same magnitude as those expected to result from neutral injection were observed in ORMAK. They appear to have no deleterious effect on the plasma. (auth)

4149 ENERGY CONTAINMENT IN THE WENDELSTEIN IIb STELLARATOR WITH OHMIC HEATING. Grieger, G.; Hacker, H.; Pacher, G.; Renner, H.; Ringler, H.; Wuersching, E. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 101-104 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

For quasi-stationary conditions in the W IIb stellarator with $B_\theta = 0.7$ T the energy containment time τ_E^l (= WE/P_{OH}) was determined for hydrogen plasmas with $T_e \simeq 150$ eV. It was found to be about 10 τ_{Bohm} in magnitude. The comparison of temperatures determined from conductivity and laser scattering gives $z_{eff} = 2.2$. (auth)

4150 ENERGY CONFINEMENT DURING HF HEATING OF PLASMA IN URAGAN STELLARATOR. Diky, A. G.; Kalinichenko, S. S.; Konovalov, I. I.; Ovchinnikov, S. S.; Pavlichenko, O. S.; Pashnev, V. K.; Slavny, A. S.; Suprunenko, V. A.; Tarasenko, V. F.; Tolok, V. T.; Shvets, O. M. (Physical Technical Inst, Kharov). pp 105-108 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Axial-nonsymmetric waves (m = 1) were used to heat the plasma. These waves were excited by the coil which created the transverse hf magnetic field in the plasma and provided energy input to the major mode. Some diagrams showing the heating process are described. (MOW)

4151 RECENT RESULTS FROM THE GARCHING HIGH-BETA STELLARATOR TORUS ISAR T 1. Fuenfer, E.; Kaufmann, M.; Lotz, W.; Neuhauser, J.; Schramm, G. (Max-Planck Institut fuer Plasmaphysik, Garching, Ger.). pp 109-112 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Experiments with the complete high beta stellarator torus ISAR T 1 are reported. The theoretically predicted M&S-like equilibrium with l = 1 helical field and small l = 2 field was established and further improved by various magnetic-field corrections. The plasma lifetime seems to be limited by m = 1 MHD instabilities in qualitative agreement with theory. (auth)

4152 LASER PLASMA CONTAINMENT IN TOR-I STELLARATOR. Andryukhina, E. D.; Voronov, G. S.; Kholnov, U. V.; Shpiegel, I. S. (Lebedev Inst. of Physics, Moscow). pp 113-116 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Functional dependences of plasma confinement time on plasma parameters and confining-magnetic-field characteristics were studied. Ion flows and longitudinal current were measured. Experimental dependences are shown not to coincide with the conclusions of neoclassical theory. (MOW)

4153 FLUCTUATIONS AND CONTAINMENT OF PLASMA IN JIPP l = 3 STELLARATOR. Dodo, T.; Fujiwara, M.; Miyamoto, K.; Ogata, A. (Nagoya Univ., Japan). pp 121-124 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Fluctuations and anomalous loss of xenon afterglow plasma in the l = 3 stellarator are observed. This instability is caused from the difference of $E_\theta \times B_\theta$ drift velocity between ions and electrons due to the finite Larmor radius effect. (auth)

4154 PLASMA CONFINEMENT BY HYBRID STELLARATOR FIELD OF l = 2 AND l = 3. Fujiwara, M.; Kawahata, K.; Mohri, A.; Miyamoto, K. (Nagoya Univ., Japan). pp 125-128 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Dependence of plasma confinement on the rotational transform angle and shear as well as the magnetic well depth is studied using JIPP stellarator which equips both l = 2 and l = 3 helical windings. Effect of shear on the resonant loss of rational surface is studied. (auth)

4155 NEUTRAL INJECTION AND OHMIC PLASMAS IN THE CULHAM LEVITRON. Alcock, M. W.; Bradford, R. E.; Freeman, R.; Hammond, D. P.; Riviere, A. C.; Sweetman, D. R. (Culham Lab., Abingdon, Eng.). pp 131-134 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Initial results are presented on the production of plasma by neutral injection and by ohmic heating. The observed containment times of the order of 0.1 second are consistent with the results of FM 1 at Princeton at the equivalent toroidal field strength. No anomalous loss of hot ions was observed, but a negative plasma potential considerably greater than kT_e/e was present during injection. (auth)

4156 PLASMA CONFINEMENT PROPERTIES IN FM-1 SPHERATOR. Chen, K.; Meade, D.; Okabayashi, M.; Schmidt, J.; Yoshikawa, S. (Princeton Univ., NJ). pp 139-142 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Plasma confinement time in FM-1 was investigated at high electron temperature(T_e = 10 to 100 eV). The confinement time is consistent with the assumption of τ = 150 to 300 τ_B. (auth)

4157 PLASMA EQUILIBRIUM IN CLEO TOKAMAK. Hugill, J.; Paul, J. W. M.; Reid, G. W.; Stott, P. E. (Culham Lab., Abingdon, Eng.). pp 157-160 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Tokamak discharges of up to 77 kA (q = 4) lasting for > 110 ms were obtained in a stainless steel vacuum vessel ($\tau \approx 0.5$ ms), using an externally applied vertical field for equilibrium. Various field configurations with slopes ($m = R/B \cdot dB/dR$) from −0.75 to +1.6 were used. (auth)

4158 HOT ELECTRON PLASMA ACCUMULATION IN AN OPEN-ENDED MINIMUM-B SYSTEM. Bardet, R.; Briand, P.; Dupas, L.; Gormezano, C.; Melin, G. (CEN, Grenoble, France). pp 247-250 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The CIRCE device is an rf-supplemented open-ended minimum-B system. A pulsed cold plasma is created outside of the mirror and is injected parallel to a progressive wave at the electron cyclotron resonance in one mirror of the magnetic bottle. A description of the experiment is given along with some of the results. (MOW)

4159 INVESTIGATION OF PLASMA CONFINEMENT BY ELECTROMAGNETIC TRAPS. Lavent'ev, O. A.; Sidorkin, V. A.; Goncharenko, V. P.; Asovskii, Yu. S.; Ovcharenko, L. I.; Potapenko, V. A.; Stepanenko, I. A.; Pankrat'ev, Yu. I.; Naboka, V. A.; Vdovin, S. A. (Physical-Technical Inst., Kiev). pp 251-254 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A schematic diagram of a general electromagnetic trap is given. Plasma is formed directly in the confinement region by high-energy electron injection through one of the magnetic gaps of the cusped configuration. The electrons accumulate between the magnetic surfaces with negative electrodes blocking the gap. Plasma decay from the trap is discussed. (MOW)

4160 200-kW NEUTRAL-BEAM INJECTION INTO THE 2XII MIRROR DEVICE. Coensgen, F. H.; Cummins, W. E.; Nexsen, W. E. Jr.; Molvik, A. W.; Simonen, T. C. (Univ. of California, Livermore). pp 255-258 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Results on injection of a 10-A, 20-keV neutral beam into the 2XII minimum-B mirror device are reported. Beam attenuation exceeding 50% is measured with approximately 10 joules deposited into the 2XII plasma. Particle deceleration at least as fast as Coulomb dynamical friction is observed. The beam does not drive instabilities. (auth)

4161 EXPERIMENTAL INVESTIGATION OF QUASI-ELASTIC REFLECTION OF A PLASMA BY A COMBINED HF-MAGNETOSTATIC MIRROR AT ECR. Dougar-Jabon, V. D.; Golovanivskii, K. S.; Pokhmelnykh, L. A. (People's Friendship Univ., Moscow). pp 259-262 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The order of adiabaticity of the reflection of a stationary beam of plasma ($n = 10^9$ cm^{-3}) with the ionic longitudinal energy $W_{i||}$ = 0.2 to 1.6 keV was experimentally investigated. It was found that with a sufficiently small gradient of the magnetic field in the ecr zone, the reflection is quasi-elastic for a wide band of the ionic energy. (auth)

4162 FURTHER STUDIES OF A HIGH-BETA REVERSED-FIELD PINCH. Gowers, C. W.; Long, J. W.; Newton, A. A.; Robinson, D. C.; Verhage, A. J. L.; Bodin, H. A. B. (Culham Lab., Abingdon, Eng.). pp 265-268 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Studies of the development of the density and temperature distributions during the decay of a stable reversed-field pinch are reported. The measurements are compared with numerical simulations of field, thermal, and particle diffusion, from which the energy confinement time is deduced. The data can be explained on a classical basis. (auth)

4163 RESISTIVE INSTABILITIES IN DIFFUSE PINCHES. Crow, J. E. (Culham Lab., Abingdon, Eng.); Killeen, J.; Robinson, D. C. pp 269-272 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The effect of finite resistance on the stability of diffuse pinches such as a tokamak and the reversed-field pinch is studied in conditions where the ratio of the skin diffusion time to Alfvén transit time, S, varies from 10^2 to 10^5. (auth)

4164 PLASMA COOLING BY IMPURITY RADIATION. Engelhardt, W.; Bateman, G. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 277-280 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Plasma cooling by impurity radiation and ionization is considered as an initial-value problem. Given the initial temperatures and a fixed concentration of oxygen impurity, the temperature reached after complete ionization of the impurity is calculated. (auth)

4165 INFLUENCE OF A LONGITUDINAL HIGH-FREQUENCY CURRENT ON PLASMA STABILITY IN A COMBINED PINCH. Zukakishvili, G. G.; Kvartskhava, I. F.; Tikhanov, E. K. (Inst. of Physics and Tech., Sukhumi, USSR). pp 281-284 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Experimental data are described on the MHD-instability stabilization in a combined pinch by a longitudinal hf current. The instability is of m = 1, the wavelength $\lambda = 2L$ type. (auth)

4166 PRODUCTION OF WEAKLY COMPRESSED HIGH-BETA PLASMAS BY SHOCK HEATING IN HIGH-VOLTAGE THETA PINCHES. Keilhacker, M.; Kornherr, M.; Niedermeyer, H.; Soeldner, F.; Steuer, K. H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 303-306 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

In the Garching 500-kV theta pinch (coil diameter 43 cm) which furnishes a fast-rising almost trapezoidal magnetic field, pulse-shock heating without adiabatic compression produces $\beta \approx 1$ plasmas with compression ratios between 2 and 3. The compressed plasma density is typically 10^{14} cm^{-3} and the ion temperature 2 keV, while the electrons are cold. (auth)

4167 SHOCK HEATING AND PLASMA-SHEATH SCALING IN LOW-DENSITY THETA PINCHES. Keilhacker, M.; Kornherr, M.; Maret, G.; Niedermeyer, H.; Steuer, K. H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 307-310 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Investigation of shock compression over a wide range of initial densities shows that at low densities ($n_0 \leq 2 \times 10^{12}$cm^{-3}) the snowplough model applies; at higher densities ($n_0 \geq 10^{13}$cm^{-3}) the free particle model applies. In the first case, the compression results in a $\beta \lesssim 0.5$ plasma, in the latter β is about 1. (auth)

4168 ION HEATING IN A STRONG MAGNETIC COMPRESSION WAVE. Chodura, R.; Roethlein, B. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 311-314 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Ion heating by fast magnetic compression is investigated in a hybrid numerical model. This model consists of a particle description for the collision-free ions and dissipative fluid description for the electrons. Time behavior of plasma dynamics during and after compression, field profiles, and ion heating rates are given. (auth)

4169 LOW-DENSITY TOKAMAK REACTOR IGNITION BY FAST NEUTRAL INJECTION AND BUILDUP OF HIGHER DENSITY BY USE OF A MOVING LIMITER. Girard, J. P.; Khelladi, M.; Marty, D. A. (CEN, Fontenay-aux-Roses, France). pp 337-340 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A tokamak reactor is considered in which the plasma radius is adjustable by means of a moving limiter, the major radius remaining constant. The expansion characteristics of the plasma are described. (MOW)

4170 BEAM—PLASMA TARGET THERMONUCLEAR SYSTEM BASED ON TOKAMAK. Demirkhanov, R. A.; Kursanov, Yu. V.; Skripal, L. P. (Inst. of Physics and Tech., Sukhumi, USSR). pp 345-348 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A stationary system in which DT reactions occur as a result of bombarding tritium plasma target by a beam of accelerated deuterons is considered. The system can serve as an energetic reactor or a breeder. (auth)

4171 DIFFUSION AND BEAM HEATING IN THE DENSE PLASMA FOCUS. Gribkov, V. A. (Lebedev Inst. of Physics, Moscow); Krokhin, O. N.; Sklizkov, G. V.; Filippov, N. V.; Filippova, T. I. pp 375-378 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Analysis of interferograms and obscurograms in soft x-rays of the plasma focus shows the following: collapse of the current sheath becomes stronger due to accumulation of impurities by means of diffusion processes; the reason for the current-sheath rupture is a high-level turbulence; and the electron-beam heating of the plasma during "second compression" is of great importance. (auth)

4172 PENETRATION OF SOLID H_2 CLUSTERS IN A PLASMA. Bottiglioni, F.; Coutant, J.; Fois, M. (CEN, Fontenay-aux-Roses, France). pp 381-384 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Experimental data obtained in the INGRA experiment concerning the attenuation of accelerated cluster beams passing through a gaseous H_2 target, as well as the corresponding production of light fragments, are described. Some preliminary computations on cluster evaporation are also discussed. (MOW)

4173 PLASMA BUILDUP IN TOROIDAL REACTORS BY NEUTRAL INJECTION. Falter, H. D.; Henkes, W. (Kernforschungszentrum, Karlsruhe, Ger.). pp 385-388 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Calculations are given for the buildup of plasma in a confinement field with the dimension of the R-85 reactor. It is shown that, using simplified assumptions, high-density plasmas can be produced in a described manner. Energy transfer between ions and electrons, the effect of thermonuclear reactions, or the effect of injection on plasma stability are not considered. (MOW)

4174 PRODUCTION OF A QUASI-STEADY-STATE HIGH-DENSITY MIRROR PLASMA. Jacquinot, J.; Leloup, C.; Poffe, J. P.; de Pretis, M. (CEN, Fontenay-aux-Roses, France). pp 389-392 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A fast sustained theta-pinch discharge, as developed in the Bille en Tête experiment, is envisaged as a target plasma for neutral-beam injection in a mirror machine. Calculations and experimental results are presented. (auth)

4175 POLARIZATION PHENOMENA IN PLASMA INJECTED INTO A MAGNETIC TRAP. Sadowski, M.; Skladnik-Sadowska, E.; Sudlitz, K.; Timofeev, A. D. (Inst. of Nuclear Research, Swierk, Poland). pp 393-396 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Experimental investigations are reported of the electric polarization of a plasma stream injected into the spherical multipole magnetic trap. Influence of small cusped regions surrounding the central minimum-B trap is also discussed. (auth)

4176 HIGH-BETA PLASMA CONFINEMENT IN A POLOIDAL MAGNETIC FIELD. Lenhert, B.; Hellsten, T.; Raggi, R. (Royal Inst. of Tech., Stockholm). pp 407-410 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Equivalent beta values as high as about 0.25 were obtained in a fully ionized rotating plasma. The plasma boundary region is sharply defined and separated from the walls of a surrounding vessel in a way consistent with a stable quasi-stationary state. (auth)

4177 DYNAMICS OF COOLING OF A DENSE WALL-CONFINED PLASMA. Chebotaev, P. Z.; Ryutov, D. D.; Spector, M. D.; Vekstein, G. E. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 411-414 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The dynamics of heating and cooling of a dense wall-confined plasma is considered. The plasma-containment time in this system is determined by means of numerical solution of hydrodynamic transport equations. The characteristic features of plasma nonmagnetic confinement are revealed, such as formation of a cold near-wall layer, plasma flow, great changes of density, and magnetic field. (auth)

4178 NONSTATIONARY EXPERIMENTS ON PLASMA CONFINEMENT IN MULTIPLE-MIRROR TRAP. Danilov, V. V.; Kruglyakov, E. P.; Shun'ko, E. V. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 415-418 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A transient decay of alkaline plasma in a multiple-mirror trap after abrupt cutoff of plasma flux was studied. The experimental results were found to be in good agreement with the existing theory of plasma confinement in multiple-mirror systems. (auth)

4179 FUSION ENERGY PRODUCTION IN A SPHERICAL, LASER HEATED DT PLASMA. Laaksonen, J.; Virtamo, J.; Jauho, P. (Technical Research Centre of Finland, Helsinki). pp 439-442 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The break-even condition in a laser-heated DT pellet, initially at solid density, is determined taking into account the finite duration of the energy equilibration between electrons and ions, the fusion energy feedback and radiation losses. The input energy required turns out to be of the order of 10^9 J. (auth)

4180 INVESTIGATION OF THE MECHANISM OF PLASMA TURBULENT HEATING. Zakatov, L. P.; Zlotnikov, D. M.; Kalinin, Yu. G.; Kingsep, A. S.; Plakhov, A. G.; Skoryupin, V. A. (Inst. of Atomic Energy, Moscow). pp 453-456 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730505-P1.

Experimental data reported indicate that, in turbulent heating, electron cyclotron oscillations occur with a polarization corresponding to theoretical predictions. These experiments were carried out in the NPK-2 installation. Plasma noises were detected by a double Langmuir probe connected with a waveguide. The anisotropy of the oscillations was investigated. An electron beam was also used to study the turbulent plasma. Current diagrams are given. (MOW)

4181 INVESTIGATION OF PLASMA HEATING BY A RELATIVISTIC ELECTRON BEAM. Abrashitov, Yu. I.; Koydan, V. S.; Konyuchov, V. V.; Lagunov, V. M.; Lukyanov, V. N.; Mekler, K. I. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 495-498 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The heating of a hydrogen plasma by a high-current relativistic electron beam was investigated for plasma in a strong magnetic field. This work is a continuation of earlier experiments. (auth)

4182 PLASMA HEATING BY INTENSE RELATIVISTIC ELECTRON BEAMS. Dove, W. F.; Gerber, K. A.; Goldenbaum, G. C.; Hammer, D. A.; Kapetanakos, C. A.; Logan, B. G. (Naval Research Lab., Washington, DC). pp 499-502 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The heating of magnetically confined plasma in the density range 10^{11} to 10^{15} cm^{-3} by intense relativistic electron beams is discussed. The presence of strong collective interactions is evidenced by coupling efficiency being much higher than "classical" mechanisms predict. The self-field effects of the $\nu/\gamma > 1$ beams are evident for the lower plasma densities. (auth)

4183 DIFFERENT THEORETICAL CHARACTERISTICS OF RF HEATING OF HOT ELECTRON–ION TOROIDAL PLASMAS. Messiaen, A. M.; Koch, R.; Vandenplas, P. E.; Weynants, R. R. (EURATOM, Brussels). pp 545-548 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A toroidal plasma column excited by a set of external coils is described by hot fluid theory. The plasma boundary is allowed to vibrate, and collisional, "turbulent", and collisionless damping are considered. Coil loading by the plasma and the external wall is computed from $\omega \ll \omega_{ci}$ up to $\omega \gg \omega_{LH}$. (auth)

4184 INVESTIGATION OF MAGNETOSONIC PLASMA HEATING IN THE TOKAMAK. Vdovin, V. L.; Zinov'ev, O. A.; Ivanov, A. A.; Kosinova, T. A.; Krotov, M. F.; Rakhimbabaev, Ya. R.; Rusanov, V. D.; Shapotkovskii, N. V. (Inst. of Atomic Energy, Moscow). pp 553-556 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Plasma was heated in a small tokamak by means of an hf generator ($f = 21$ and 36 Mc) connected with the plasma by a narrow loop. The loop was inserted into the liner and isolated with quartz from the plasma. The experiments with hydrogen and deuterium were carried out using the semisinusoidal current pulse of 3-msec duration and amplitude 10 kA; the plasma column diameter was about 12 cm. (MOW)

4185 LINEAR DISCHARGE TURBULENT HEATING EXPERIMENT: ION HEATING AND OSCILLATIONS WITH FREQUENCIES NEAR f_{pi}. Adati, K. (Nagoya Univ., Japan); Sugihara, R.; Uyama, T.; Watanabe, K. pp 561-564 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The temporal variation of the intensity of oscillations around the ion plasma frequency f_{pi} was compared with that of the Doppler broadening of the He II 4686-Å line. It was found that the ion heating is not observed during excitation of oscillations of high intensity, but rather during that of low intensity. (auth)

4186 RF TURBULENCE HEATING IN TOROIDAL MACHINE. Corti, S.; Lisitano, G.; Pacher, G.; Renner, H.; Ringler, H.; Wuersching, E. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 565-568 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Rf-wave-launching structures (L-Coils) were excited in a stellarator. The characteristics of the discharge are presented. They cannot be explained by known wave–plasma interactions except by rf turbulence heating. (auth)

4187 PLASMA HEATING AND DAMPING OF THE FAST WAVE NEAR THE SECOND HARMONIC OF THE ION CYCLOTRON FREQUENCY. Dollinger, R. (Texas Tech. Univ., Lubbock); Kristiansen, M.; Hagler, M. O.; Bergstroem, J. pp 583-586 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics: Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Wave damping and plasma heating were observed for the fast (right-hand polarized) wave near the second harmonic of the ion cyclotron frequency (Ω_i) in the dense plasma ($\gtrsim 10^{20}$ m^{-3}). The wave was launched with a 60% field modulation and damped in a magnetic beach where $\omega \rightarrow 2\Omega_i$. (auth)

4188 LOCALISATION OF ELECTROMAGNETIC WAVE ABSORPTION PROCESSES IN A PLASMA OF TOROIDAL DISCHARGE. Golant, V. E.; Larionov, M. M.; Levin, L. S.; Pakhomov, L. P.; Podushnikova, K. A.; Rozhdestvenskii, V. V.; Serebrenyi, G. A. (Ioffe Inst. of Physics and Tech., Leningrad). pp 587-590 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

In the Tokamak FT-I device, efficiency and localization of microwave power absorption in a plasma were studied. For this purpose, a method of light intensity measurements was applied. Gyro-resonance absorption at second harmonics of electron cyclotron frequency and absorption due to electromagnetic wave transformation into the plasma wave in upper-hybrid-resonance conditions were observed. (auth)

4189 SHOCK HEATING IN TOROIDAL SYSTEMS WITH ELONGATED CROSS SECTION. Es'kov, A. G.; Kurtmullaev, R. Kh.; Malyutin, A. I.; Semenov, V. N.; Chernyakov, A. L. (Inst. of Atomic Energy, Moscow). pp 595-598 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Some possible ways are considered for widening the range of shock-plasma heating in an elongated toroidal configuration up to $nT \sim 10^{18} + 10^{19}$ eV/cm^3 at $T \sim 1$ to 10 keV, including a method of controlled magnetic fluxes reconnection for the formation of a powerful shock piston. (auth)

4190 MOTION OF CHARGED PARTICLES IN A MIRROR MACHINE IN PRESENCE OF CYCLOTRON OSCILLATIONS. Timofeev, A. V. (Inst. of Atomic Energy, Moscow). pp 613-616 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The chaotic motion condition of charged particles in a mirror machine in the presence of cyclotron oscillations was determined. It was found that the particles losses from mirror machines under the influence of cyclotron oscillations with small wavelengths can be very small. The development of the cyclotron instability in mirror machines often leads to the regular oscillations with a fixed frequency ω and the wave vector $\vec{k}$, often additional losses of the particles turning out to be very small. The question of losses is discussed. (auth)

4191 ABSORPTION OF ALFVEN WAVES IN A PLASMA CYLINDER WITH DISTRIBUTED CURRENT. Jankovich, Z. (Inst. Nuclear Research, Sverk, Poland). pp 621-624 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Resonant absorption of Alfvén waves by a current-carrying plasma is considered in connection with plasma heating in tokamak-type systems. (auth)

Diagnostics

Refer also to abstract 4126.

4192 EXPERIMENTAL DETERMINATION OF THE SPECTRAL INDEX OF A TURBULENT PLASMA FROM DIGITALLY COMPUTED POWER SPECTRA. Smith, D.E.; Powers, E.J. (Department of Electrical Engineering and Electronics Research Center, The University of Texas at Austin, Austin, Texas 78712). Phys. Fluids 16: No. 8, 1373-1374 (Aug 1973).

Digitally implemented power spectra techniques are used to determine the spectral index of the turbulent plasma while simultaneously verifying the existence of a linear relationship between k and ω which is necessary to compare theory and experiment. (auth)

4193 ELECTRON DENSITY IN A LOCALLY IONIZED PLASMA AFTERGLOW. Martin, B.E. Jr.; Ventrice, C.A. (Electrical Engineering Department, Tennessee Technological University, Cookeville, Tennessee 38501). J. Appl. Phys. 44: No. 9, 4216-4217 (Sept 1973).

An expression is derived for the electron density distribution in a weakly ionized plasma afterglow. The case for which the ionization is symmetrically localized about the center of the chamber is considered. It is shown that localization causes the existence of higher-order modes of decay to be present in the afterglow. (auth)

4194 NEUTRAL-DENSITY DETERMINATION BY SCATTERING OF VACUUM-UV RADIATION. Breton, C.; Papoular, R. (CEN, Fontenay-Aux-Roses, France). pp 183-186 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The purpose of the diagnostic method described is to determine the spatial distribution of the neutral-atom density in a plasma machine, without having recourse to any conspicuous assumption regarding the statistical distribution of excited populations. (auth)

4195 MEASUREMENT OF MAGNETIC FIELD DIRECTION IN TOKAMAK PLASMA USING POLARIZATION OF AN IMPURITY LINE. Fujita, J.; McCormick, K. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 191-194 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A method for measuring the poloidal magnetic field in a tokamak discharge is described. The field resolution expected for typical plasma parameters is indicated. Test results for a part of the diagnostic apparatus are shown. (auth)

4196 POLOIDAL FIELD MEASUREMENTS IN THE ST TOKAMAK BY HARMONIC GENERATION AT THE UPPER HYBRID LAYER. Cano, R.; Fidone, I.; Hosea, J. (Princeton Univ., NJ). pp 195-198 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A locally generated extraordinary wave with frequency Ω, propagating in a plasma with $\omega_p \ll \omega_c \lesssim \Omega/2$, maintains its initial polarization. Therefore, remote polarization measurements yield the direction of the confining magnetic field at the point of generation. Some data are discussed. (MOW)

4197 SPACE POTENTIAL MEASUREMENTS IN THE ST TOKAMAK. Jobes, F. C.; Hosea, J. C. (Princeton Univ., NJ). pp 199-202 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

An ion beam probe was used to make a systematic investigation of the space potential, both as a function of time and discharge conditions. Of particular interest is the dependence of the space potential on the concentration of runaway electrons in the ST plasma and its behavior leading into and during the disruptive instability. The system and some typical results are described. (MOW)

4198 VARIATION OF TEMPERATURE OF LASER-PRODUCED PLASMAS WITH LASER AND TARGET PARAMETERS. Klein, B. M.; Dozier, C. M.; Nagel, D. J.; Whitlock, R. R. (Naval Research Lab., Washington, DC). pp 443–446 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

It is shown how x-ray spectral data may be used to deduce the electron temperature of laser-produced plasmas. Results for Al plasmas are discussed. (auth)

4199 METHOD AND MEANS FOR MEASURING THE ANISOTROPY OF A PLASMA IN A MAGNETIC FIELD. Shohet, J. L.; Greene, D. G. S. (to United States Atomic Energy Commission). US Patent 3,767,929. 23 Oct 1973. Filed date 15 Jun 1972. 8p.

Anisotropy is measured of a free–free-bremsstrahlung-radiation-generating plasma in a magnetic field by collimating the free–free bremsstrahlung radiation in a direction normal to the magnetic field and scattering the collimated free–free bremsstrahlung radiation to resolve the radiation into its vector components in a plane parallel to the electric field of the bremsstrahlung radiation. The scattered vector components are counted at particular energy levels in a direction parallel to the magnetic field and also normal to the magnetic field of the plasma to provide a measure of anisotropy of the plasma. (Official Gazette)

Kinetics (General)

Refer also to abstract 3267.

4200 (FUPH-G-4) PROGRESS REPORT ON CONTROLLED FUSION RESEARCH. Brennan, M. H. (Flinders Univ. of South Australia, Bedford Park. School of Physical Sciences). Sep 1973. 21p. Dep. NTIS (U.S. Sales Only) $3.25.

The current status of the international research program directed towards developing a fusion reactor for electricity production is assessed. Information is obtained mainly from meetings of the International Fusion Research Council (July 29 and Aug. 1, 1973) and the Sixth European Conference on Controlled Fusion and Plasma Physics held in Moscow from July 30 to August 3, 1973. The major items of business discussed at the meeting of the International Fusion Research Council are presented and the various national research programs are outlined. Finally, the Australian program is considered. (AT)

4201 SIMULATION OF A TRANSIENT dc BREAKDOWN IN A PENNING MIXTURE BETWEEN TWO CLOSELY SPACED PARALLEL ELECTRODES. Lay, F.M.; Chu, C.K. (International Business Machines Corporation, System Development Division, Kingston, New York 12401). J. Appl. Phys. 44: No. 9, 4008-4012 (Sept 1973).

The results of a numerical simulation of a dc gas discharge in a mixture of neon + 0.1% argon are presented. The simulation is based upon a Townsend avalanche mechanism (direct ionization) and the ion secondary effect. The effect of the delayed electron due to Penning collision (indirect ionization) in the mixture is fully accounted for. Comparisons with the experimental results of Penning and co-workers are also made. (auth)

4202 EXPERIMENTAL OBSERVATIONS OF THE THERMAL EXPANSION OF A PLASMA. Goldenbaum, G.C.; Gerber, K.A. (Naval Research Laboratory, Washington, D. C. 20390). Phys. Fluids 16: No. 8, 1289-1297 (Aug 1973).

A dense argon plasma ($n_e = 4 \times 10^{18}\text{cm}^{-3}$, KT = 4 eV) is created and allowed to expand either into a vacuum or into a low density, partially ionized plasma. Expansion into a vacuum is shown to be dominated by electric-field effects which accelerate ions to much higher energies ($E \lesssim 180$ eV) than the original thermal energy. Expansion into a low density ($n_e = 1 \times 10^{13}\text{cm}^{-3}$) 10% ionized plasma of the same species was dominated by resonant charge exchange giving the appearance of momentum transfer. Expansion into a hydrogen plasma shows essentially complete momentum transfer as in a blast wave. Expansion of a hydrogen plasma into an ambient argon plasma shows spatially separated regions in which the hydrogen appears to collisionally snowplow the argon plasma. (auth)

4203 STUDYING CYLINDRICAL SHOCKWAVES ON THE AXIS OF A THETA PINCH. Bogen, P. (Kernforschungsanlage, Juelich, Ger.). (1973). vp. (In German).

From spring meeting of the German Physical Society; pulse physics, plasma physics and gas discharges, quantum optics; Berlin, Germany (9 Apr 1973).

The theory of cylindrical shock waves in ideal liquids shows that Mach number and pressure increase on approaching the axis. This effect of convergence is not observed in general in theta pinches because the distance axis, i.e., piston is not very large compared to the thickness of the shock wave. By selecting the Mach number ($M \sim 4$), it was tried to keep this thickness small. By means of Thomson scattering the following were measured on the axis in the reflected wave: $n(e) = 6.5 \times 10^{15}\text{cm}^{-3}$, $T(e) = 16$ eV, and kinetic pressure = 7 times the piston pressure of the magnetic field. This implies a weak convergence effect. (GE)

4204 LONG-WAVELENGTH HELICAL PLASMA EQUILIBRIUM WITH A FREE BOUNDARY. Tanaka, M.; Azumi, M.; Takasi, T. (Japan Atomic Energy Research Inst., Tokai). J. Phys. Soc. Jap.; 34: No. 6, 1645-1648(Jun 1973).

A method is presented to obtain a straight free boundary plasma equilibrium of helical symmetry. The exterior vacuum magnetic field around a prescribed plasma equilibrium with a long wavelength is determined using complex functions. The m-fold ($m \geq 2$) helical equilibrium slightly distorted from a circular cylinder is obtained together with the $m = 1$ equilibrium of finite amplitude. (auth)

4205 DISTRIBUTIONS OF PLASMA DENSITY AND BETA IN HIGH-BETA PINCHES. Newton, A. A. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 13: No. 5, 759-761(Oct 1973).

Predictions from a simple analytical theory were compared with results from six theta-pinch experiments. Data were selected for a time during each experiment after the implosion but before axial electron thermal conduction became significant. Thus the measured plasma properties were determined only in the formation stage. Density distribution data are shown. (MOW)

4206 FLOW OF NONISOTHERMAL PLASMA THROUGH A MAGNETIC NOZZLE. Kuznetsov, V. V.; Semashko, N. N. Sov. Phys. Tech. Phys. (Engl. Transl.); 17: No. 11, 1899-1900(May 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 11, 2440-2442(Nov 1972).

A theoretical and experimental study is made of the flow of a nonisothermal plasma through a Laval magnetic nozzle. The presence in such a plasma of warm electrodes ($T_{eW} \simeq 20$ eV) along with hot electrons results in the appearance of two regions of sharply differing steady-state electric field gradient and, correspondingly, sharply differing ion velocities. The two regions are separated by a potential jump. The flow is quasi-neutral everywhere except in the vicinity of the jump, where a charged double layer exists. The layer is responsible for the finite width of the jump. (auth)

4207 INTENSITY OF STIMULATED MANDELSTAM–BRILLOUIN SCATTERING IN A PLASMA. Gorbunov, L. M. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 3, 990-996(Sep 1973). (In Russian).

SMBS in a plasma is considered under conditions of applicability of the hydrodynamic approximation with allowance for nonlinearity of the excited sound waves. It is shown that, even near the threshold, the intensity of the scattered radiation may be significant. (auth)

4208 IMPLODING-LINER FUSION DEVICES. Boris, J. P.; Robson, A. E.; Shanny, R. A.; Winsor, N. K. (Naval Research Lab., Washington, DC). pp 315-318 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Fusion systems based on the adiabatic compression of plasma by megagauss magnetic fields generated by electromagnetically imploded metal liners in θ-pinch and cusp geometry are described. (auth)

4209 INJECTION OF RELATIVISTIC ELECTRON BEAMS WITH ARBITRARY RADIAL PROFILES INTO WARM PLASMAS WITH COLLISIONS. Kueppers, G.; Salat, A.; Wimmel, H. K. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 511-514 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The effect of collisions and finite plasma pressure on charge and current screening for an arbitrary beam profile is investigated. The electron beam was assumed to be of small density as compared to plasma density. The theoretical analysis is described. (MOW)

Kinetics (Experimental)

4210 (CEA-CONF-2386) SYNCHROTRON RADIATION SPECTRUM NEAR THE ELECTRON CYCLOTRON FREQUENCY AND ITS FIRST HARMONIC; DEDUCTION OF THE ELECTRON DISTRIBUTION FUNCTION. Jacquinot, J.; Poffe, J. P.; Waldes, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). [nd]. 4p. (CONF-730906-12). Dep. NTIS (U.S. Sales Only) $3.00.

From 11th international conference on phenomena in ionized gases; Prague, Czechoslovakia (10 Sep 1973).

A hot ($\langle E \rangle \simeq 20$ keV), tenuous plasma ($n_e < 10^{11}$ cm^{-3}) confined in a fairly homogeneous field ($\Delta B/B < 1.16$) is considered. In such a plasma synchrotron radiation is composed of well-defined lines emitted at frequencies slightly below $n\nu_c(\eta = 1,2)$ where ν_c is the cyclotron frequency of an electron at rest. The radiation emitted, in the extraordinary mode, in a direction perpendicular to the magnetic induction is discussed. The dominant broadening process of the lines comes from the relativistic change of mass. However, nonuniformity of the magnetic field and Doppler shifts may produce small parasitic-broadening effects. The weak normalized density ($\omega_p^2/\omega_c^2 < 0.1$) and the high electron temperature reduce to a negligible level the broadening effects produced by the other possible mechanisms (radiation and collisional broadening, self-absorption, and plasma dispersion effects). (MOW)

4211 HOT-ELECTRON PLASMA IN THE LEVITATED SPHERATOR. Okabayshi, M.; Voitsenya, V.; Ripin, B.; Schmidt, J.; Yoshikawa, S. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 8, 1337-1348 (Aug 1973).

In the hot-electron plasma experiment of the levitated spherator, it is found that hot electrons initially trapped in the mirror section are diffused out by electron–neutral collisions resulting in the establishment of the equilibrium between the trapped hot electrons and circulating hot electrons. The confinement time reaches 6 sec at the neutral pressure of 2×10^{-7} Torr, which is about one-third of the classical decay time across the magnetic field. The time dependence of the density of the circulating hot electrons is in good agreement with the numerical calculations based on the Fokker–Planck equation. However, the existence of circulating hot electrons is sensitive to the magnetic field error of 1%. The establishment of the inductive current of the hot electron plasma is also investigated. (auth)

4212 OBSERVATION OF FREE–STREAMING ELECTRONS IN PLASMAS. Kawai, Y.; Nakamura, Y.; Itoh, T.; Kawabe, T. (Institute of Plasma Physics, Nagoya University, Nagoya, Japan). Phys. Fluids 16: No. 8, 1307-1310 (Aug 1973).

The excitation and propagation of electron waves in a plasma have been studied experimentally in a low-density and large-volume plasma. For frequencies larger than the electron Langmuir frequency, an electron plasma wave was observed which is predicted by the linear theory for a Maxwellian plasma. For smaller frequencies, free-streaming electron or ballistic signals are observed. For frequencies close to the electron Langmuir frequency, both the electron plasma wave and the free–streaming electron are excited and show interference patterns. These observations are compared with the theoretical predictions. The effect of a sheath formed around a transmitter on the free–streaming electron is also discussed. (auth)

4213 ELECTRON AND ION MOMENTUM TRANSFER FROM PLASMA ELECTRICAL CONDUCTIVITY IN A MAGNETIC FIELD. Albares, D.J. (Quantum Electronics Division, National Bureau of Standards, Boulder, Colorado 80302). Phys. Fluids 16: No. 8, 1252-1259 (Aug 1973).

The electrical conductivity of a partially to strongly (Coulomb collision–dominated) ionized dc plasma in a dc magnetic field was investigated at low frequency by two experimental methods, one utilizing the Hall effect and the other a plasma interaction with an induced solenidal electric field. Electron–ion and electron–atom momentum transfer collision frequencies and ion mobility in the magnetic field (ion slip) were inferred. The helium abnormal negative glow plasma was used at pressures of 0.5 to 2.5 Torr, electron densities of 1 to 32×10^{17} m^{-3} and temperature ≈ 600 °K; the magnetic field ranged up to 675 G. The data support Shkarofsky's theory of partial ionization. When ion motion becomes dominant, the resulting ion mobility is 75% larger that He^+ mobility in helium taken from drift tube measurements. This disagreement suggests that further theoretical work on ion mobility in a plasma is needed. (auth)

4214 TIME AND SPATIAL RESOLVED DETERMINATION OF ELECTRON DENSITY OF THE JUELICH PLASMA FOCUS. Schmidt, H. (Univ., Stuttgart); Conrads, H. (1973). vp. (In German).

From spring meeting of the German Physical Society: pulse physics, plasma physics and gas discharges, quantum optics; Berlin, Germany (9 Apr 1973).

To determine the electron density, two separate methods have been applied: interferometry and refraction of an accurately collimated laser beam (514 nm). Smear photographs show in both cases that 100 ns before the start of the focusing phase, despite undisturbed self-luminous behavior of the streaming in plasma, the laser beam is greatly disturbed. At this time the electron density is 5×10^{18} cm^{-3}. The duration of the perturbation is 50 to 70 ns. During this time the laser beam seems to undergo a strong absorption which implies that the plasma surrounded by the current carrying layer becomes optically thick. A beam bending by refraction up to 8 mrad was observed, which corresponds to a density of for example 5×10^{19} electrons per cm^3 during the focusing phase. (GE)

4215 PRE-IONIZATION IN Z-PINCH AT 1 mTORR PRESSURE. Lange, F. D.; Soeldner, F.; Steuer, K. H. (Max-Planck Institut fuer Plasmaphysik, Garching, Ger.). (1973). vp. (In German).

From spring meeting of the German Physical Society: pulse physics, plasma physics and gas discharges, quantum optics; Berlin, Germany (9 Apr 1973).

By systematically varying several elements, a suitable electronic circuit has been developed by which a slide spark is triggered off in order to facilitate ignition of the main discharge. Plasma diagnostics was carried out by microwave interferometry (density measurements), a multiprobe (azimuthal magnetic field), scintillators (x-ray irradiation) and lasers (temperature and radial density profile). The degree of ionization increases proportionally to the current amplitude; the plasma luminosity shows a periodic structure corresponding to the double current frequency; the density profile is found to be reproducible after about 30 μs (homogeneous plasma with an ionization of 50%). These results show that preionization is a suitable method for shock wave experiments with the 500-kV Theta pinch, with initial densities of about 10^{13} cm^{-3}. (GE)

4216 REACTION RATE COEFFICIENT FOR RADIATIVE ELECTRON ATTACHMENT TO ATOMS. Janev, R. K. (Inst. of Physics, Belgrade); Petkovski, L. J. Fizika (Zagreb); 5: No. 3, 155-158(Aug 1973).

The coefficient for radiative electron attachment to atoms with $^2S_{1/2}$ ground-state configuration is calculated. The process of radiative electron attachment to atoms has been found to be one of the most important sources of continuous radiation from some astrophysical and laboratory plasmas. Results of the calculations for hydrogen and alkali atoms are given at T = 300, 1000, 3000, 6000, and 10,000 K. The alkali atoms include results on Li, Na, K, Rb, and Cs. (MCW)

4217 PLASMA DYNAMICS AND CURRENT-SHEATH STRUCTURE IN COLLISION-FREE THETA PINCHES. Hoethker, K.; Dietz, K. J.; Dippel, K. H.; Hintz, E. (Kernforschungsanlage, Juelich, Ger.). pp 299-302 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Results are presented of experimental studies of the piston-induced radial plasma flow and of the electron density, the electron temperature, and the magnetic field distribution in the piston region. The following initial conditions were used for this work: $n_e = 5 \times 10^{12}$ cm^{-3}, $u_p \approx 5 \times 10^7$ cm/sec, $T_e = 2.5$ eV, and B < 10 G. (MOW)

4218 MEASUREMENT OF ION TEMPERATURE AND MAGNETIC FIELD IN A DENSE PLASMA FOCUS. Forrest, M. J.; Norton, B. A.; Peacock, N. J. (Culham Lab., Abingdon, Eng.). pp 363-366 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Recent measurements of ion and electron temperatures in pure deuterium plasma by laser scattering give $T_i = 3$ keV and $T_e = 2$ keV in contrast to results in Ne-doped plasma where $T_i = 0.7$ keV and $T_e = 2.25$ keV. The magnetic field during pinch collapse was estimated from measurements of the Zeeman splitting of the carbon V 2271-Å line to be between 0.8×10^6 and 2×10^6 G. (auth)

4219 ELECTRON DENSITY OF A PLASMA FOCUS AND THE RADIATION EMITTED AT THE PLASMA FREQUENCY AND ITS HARMONICS. Conrads, H. (Institut fuer Plasmaphysik, Juelich, Ger.); Gollwitzer, D.; Schmidt, H. pp 367-370 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma

physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The electron density of a plasma focus was measured as a function of time during 150 nsec, when the focus is formed reaching a peak density of 5×10^{19} per cm^3 on axis. The absolute intensity of the radiation was measured in the spectral range of 0.5 to 12 μm, where the plasma frequency and its harmonics are positioned. (auth)

4220 MEASUREMENTS OF PHASE AND GROUP VELOCITY OF THE ELECTRON CYCLOTRON INSTABILITY IN A BEAM–PLASMA EXPERIMENT. Cabral, J. A. C.; Silva, M. E. F. (Instituto Superior Tecnico, Lisbon). pp 521-524 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The phase and group velocities of the cyclotron instability were measured. These measurements were performed with a sampling oscilloscope. It was verified that the phase velocity is about 70% of the beam velocity and that the group velocity is of the order of the thermal velocity of the plasma electrons. (auth)

4221 CO_2 LASER-BEAM ABSORPTION BY A PLASMA NEAR PLASMA FREQUENCY. Fabre, E.; Stenz, C.; Maignan, J. (CNRS, Paris). pp 603-606 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The interaction of CO_2 laser radiation with a dense plasma near the plasma frequency is studied. The absorption of laser light corresponds, for flux below 10^{10} W/cm^2, to inverse bremsstrahlung. (auth)

Kinetics (Theoretical)

4222 SIMPLE MODELS OF SOLID AND HOLLOW RELATIVISTIC ELECTRON BEAMS WITH ARBITRARILY HIGH CURRENT. Lawson, J.D. (Rutherford High Energy Laboratory, Chilton, Berkshire, England). Phys. Fluids 16: No. 8, 1298-1299 (Aug 1973).

A model of a neutralized electron beam in which the electrons make helical orbits about the axis is described. This differs from previous models in that there is no longitudinal field or azimuthal current. Three particular cases, corresponding to (1) uniform charge density in a solid beam, (2) uniform current density in a solid beam, and (3) uniform charge density in a hollow beam are analyzed. In none of these configurations is there a current limit, and all the electrons move in the forward direction. (auth)

4223 THEORY OF A STEADY-STATE NONISOTHERMAL POSITIVE COLUMN IN A MAGNETIC FIELD. Ilić, D.B. (Institute for Plasma Research, Stanford University, Stanford, California 94305). J. Appl. Phys. 44: No. 9, 3993-4001 (Sept 1973).

The steady state of a nonisothermal cylindrical discharge in a longitudinal magnetic field is described by three moment equations in the plasma approximation for electrons and ions. Volume generation of electron–ion pairs by single-stage ionization, the presence of axial current, and collisions with neutrals are considered. The theory yields radial profiles of the charged particle velocities, density, potential, electron and ion temperatures, and demonstrates similarity laws for the positive column. The results are compared with two-moment theories and with experimental data on helium, argon, and mercury vapor found in the literature for a wide range of pressures. (auth)

4224 ENERGY BALANCE IN LOW-PRESSURE GAS DISCHARGES. Vriens, L. (Philips Research Laboratories, Eindhoven, The Netherlands). J. Appl. Phys. 44: No. 9, 3980-3989 (Sept 1973).

In the positive column of low-pressure gas discharges, the electron energy distribution can be markedly non-Maxwellian, in particular in the tail of the distribution at low degrees of ionization. A method is described which enables one to account for large deviations from a Maxwellian distribution when calculating collision rates, energy flow terms, excited-state densities, and the radiation output. Illustrative examples are given for Cs-Ar, Ar, and Hg-Ar discharges. Possible extensions and applications of the method are briefly discussed. Analytical formulas are derived for (i) the Coulomb relaxation between the electrons and (ii) the cross sections for ionization from excited states. (auth)

4225 EQUILIBRIUM OF A PLASMA IN TRANSLATIONALLY SYMMETRIC HYBRID SYSTEMS. Matsui, T.; Tanaka, Y.; Okuda, T. (Nagoya Univ., Japan). Nucl. Fusion; 13: No. 5, 671-675(Oct 1973).

The dependence of the cross section and the current distribution on an applied magnetic field in translationally symmetric hybrid systems, in which the magnetic field is produced by external conductors and plasma currents, is considered. If the flux function and the plasma boundary are expanded in Fourier series, this dependence is obtained as relationships between Fourier coefficients. In a first approximation, the cross section and the current distribution are determined by the applied magnetic field, and for some cases a conducting wall is necessary. (auth)

4226 PENETRATION OF A LONGITUDINAL MAGNETIC FIELD INTO A PLASMA OF A LINEAR DISCHARGE. Breizman, B. N.; Ryutov, D. D. (Inst. of Nuclear Physics, Novosibirsk, USSR). Nucl. Fusion; 13: No. 5, 749-750(Oct 1973).

In an earlier experiment the propagation time of a magnetic field pulse from the boundary to the axis of an electrode-ended plasma column was measured. An interesting feature of the experiment was that the mean signal velocity turned out to be anomalously high (at least, an order of magnitude higher than the Alfvén velocity). One of the possible mechanisms of such fast field penetration into a plasma is theoretically discussed here. (MOW)

4227 COMPRESSION LIMITATIONS IN BELT PINCHES. Kadish, A. (FOM Instituut voor Plasmafysica, Jutphas, Netherlands). Nucl. Fusion; 13: No. 5, 756-757(Oct 1973).

A surface-current model is used to discuss observed limitations for the column compression ratio. Toroidal-curvature effects are neglected. A vacuum magnetic field, with associated poloidal flux, is assumed to occupy the planar region between the outer boundary and a uniform column with pressure. The vacuum field is assumed to provide an equilibrium for the column by pressure balance. It is shown that if the toroidal cross sections are not convex, it is possible to achieve compression ratios significantly greater than two. (MOW)

4228 POSSIBLE LONG-RANGE ORDERING AND RELATIVISTIC PLASMAS. Krizan, J. E. (Univ. of Vermont, Burlington). Nucl. Fusion; 13: No. 5, 757-759(Oct 1973).

The discussion shows that a hot plasma exhibits long-range ordering that would be manifested by a tendency to keep the long-range magnetic field either zero or a minimum in a plasma. Thus, the response to an axisymmetric applied field could be visualized in terms of current loops of extent πr_{μ}, which produced behavior that tends to be diamagnetic. Such an ordering implies a phase-transition region at temperatures of the order of 10^{6}°K. (MOW)

4229 RADIAL TRANSPORT OF IONS IN TOKAMAKS INCLUDING DIFFUSING OXYGEN AND CARBON IMPURITIES. Duechs, D. F. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Furth, H. P.; Rutherford, P. H. pp 29-32 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Ionization-rate coefficients and radiative-recombination coefficients are considered in the analysis. Loss terms are considered for ionization and line and continuum radiation as well as bremsstrahlung. The model also includes recycling cold neutral gas and four generations of charge-exchange-created hot neutrals. (MOW)

4230 MHD SIMULATION OF ANISOTROPIC TOROIDAL PLASMAS. Sharp, W.; Taylor, J. C. (Univ. of Glasgow). pp 45-48 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Solutions for the MHD equations for a one-fluid magnetoplasma are discussed. Some typical data for a hydrogen plasma in a toroidal configuration are described. (MOW)

4231 INFLUENCE OF SLOW INHOMOGENEITIES OF TRANSPORT PHENOMENA IN HIGH-TEMPERATURE PLASMA IN STRONG MAGNETIC FIELDS. Dreizin, Yu. A.; Dykhne, A. M. (Inst. of Atomic Energy, Moscow). pp 147-150 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Drift-approximation analysis of the motion of electrons in time-independent random potential φ is given. It is shown that the coefficient of electron diffusion $D_{\perp}$ across a magnetic field depends on the free path ρ, Larmor radius $\sqrt{H}$, a characteristic scale α of inhomogeneities, and the dimensionless amplitude $\Delta \sim \rho\varphi/T$. (auth)

4232 KINETIC MODEL FOR THE NEUTRAL GAS BETWEEN PLASMA AND WALL. Rehker, S.; Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 187-190 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma

physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The Boltzmann equation with charge exchange and ionization as elementary processes is used in the analysis. Different reflection mechanisms on the wall are taken into account. The plasma distribution functions are Maxwellian. (MOW)

4233 STATIONARY CONVECTION IN TOKAMAK PLASMAS. Maschke, E. K.; Paris, R. B. (CEN, Fontenay-aux-Roses, France). pp 205-208 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

During its time evolution a tokamak plasma may become locally unstable according to ideal MHD theory (e.g., $q_{axis} < 1$, or skin effect). If viscosity and resistivity are taken into account, a quasi-stationary convective motion is possible, which is characterized by a critical Rayleigh number and leads to enhanced thermal transport. (auth)

4234 MULTIPOLE TOKAMAK EQUILIBRIA WITH FINITE β. Feneberg, W.; Lackner, K. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 209-212 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A method is described for the computation of plasma configurations with various current profiles and finite poloidal β, held in equilibrium by given external currents. Applications to configurations combining the elliptic and triangular deformations desirable for stability with magnetic divertors are given. (auth)

4235 EQUILIBRIUM ROTATION OF A TOKAMAK DURING NEUTRAL INJECTION. Canobbio, E.; De Barbieri, O. (CEN, Grenoble, France). pp 213-216 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The steady-state rotation velocity of a tokamak plasma in the plateau regime was studied in the presence of neutral beams injected for heating purposes. (auth)

4236 SIMULATION OF CLASSICAL TOROIDAL PLASMAS IN THE PLANE. Potter, D. E.; Tuttle, G. H. (Imperial Coll. of Science and Tech., London). pp 217-220 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A fluid model to describe classical, axisymmetric, toroidal plasmas in the poloidal plane is briefly described. A low- but finite-beta plasma is assumed so that both the motion of the field lines and the plasma are included. The equations are expressed on an orthogonalized field-line space and solved implicitly on the computer. The simulation was applied to the tokamak, where the full time scale of the experiment is followed and the creation of an equilibrium, diffusion, energy losses, and decay are studied. (auth)

4237 VARIATION OF A TOROIDAL EQUILIBRIUM. Bineau, M. (CEN, Fontenay-aux-Roses, France). pp 221-224 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

An analysis is described for a set of equilibrium equations. It is found that when the given equilibrium is axisymmetric, the linearized system has a unique solution, which is axisymmetrical. An analysis for nonsymmetrical equilibrium is also given. (MOW)

4238 ARBITRARILY SHAPED RESISTIVE TOKAMAK EQUILIBRIA. Green, B. J.; von Hagenow, K. U.; Zehrfeld, H. P. (Max Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 225-228 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

In contrast with the usual treatments of tokamak equilibria, the effects of resistivity are self-consistently included. This makes the problem physically well posed and, in particular, allows the determination of the current density profiles. Situations of arbitrary cross section and aspect ratio can be considered. (auth)

4239 EFFECT OF PLASMA FLOW ON TOROIDAL EQUILIBRIUM SHIFT. Green, B. J.; Zehrfeld, H. P. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 229-232 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Neutral injection in toroidal systems leads unavoidably to plasma flow. Such flows affect the position and form of the magnetic surfaces. It is shown that modifications of the toroidal plasma shift can be of the same order as the no-flow shift. This necessitates a reinterpretation of column-position diagnostics in tokamak systems. (auth)

4240 TWO-DIMENSIONAL COMPUTER CALCULATION OF TOROIDAL PINCH EXPERIMENTS. Hofmann, F.; Ignat, D. W. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). pp 289-292 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A two-dimensional, three-fluid, magnetohydrodynamic computer code was developed for numerical calculation of toroidal pinches with arbitrary cross section and aspect ratio. The code is applied to the study of the initial phase of a toroidal screw pinch with highly elongated plasma cross section (belt pinch). (auth)

4241 NEOCLASSICAL DIFFUSION OF α PARTICLES. Nocentini, A.; Tessarotto, M. (Univ., Trieste, Italy). pp 329-332 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A generalization of neoclassical diffusion theory to a 3-component plasma, containing also α particles generated in fusion events, was elaborated. The resulting diffusion of the α particles can again be made intuitive using a simple random-walk model. (auth)

4242 CHARACTERISTIC CURVES AND SCALING LAWS FOR A MATHER-TYPE PLASMA FOCUS. Rapp, H.; Trunk, M. (Univ., Stuttgart). pp 371-374 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

From experimental and theoretical studies for a focus machine of the Mather type, characteristic curves and scaling laws are established. Neutron and x-ray radiation characteristics are presented, and results of MHD calculations are interpreted. (auth)

4243 PLASMA STREAMS IN INHOMOGENEOUS MAGNETIC FIELDS. Karlson, E. T. (Royal Inst. of Tech., Stockholm). pp 397-400 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The adiabatic motion of a finite plasma stream in an inhomogeneous, transverse magnetic field is studied theoretically. Some results are given also for the adiabatic motion of a finite plasma stream in a curved magnetic field. (auth)

4244 NUMERICAL SIMULATION OF HIGH-FREQUENCY HEATING OF PLASMA. Sigov, Yu. S.; Khodirev, Yu. V. (Inst. of Applied Mathematics, Moscow). pp 579-582 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

In one-dimensional computer experiments, the kinetic phenomena in rarefied plasma driven by a large electric field oscillating at nearly the electron plasma frequency and then at twice the electron plasma frequency are investigated. Strong parametric instabilities and anomalous absorption of hf driver-field energy are observed. (auth)

4245 STRUCTURE OF A BOUNDARY LAYER SEPARATING A FIELD FREE PLASMA FROM A VACUUM MAGNETIC FIELD. Gruber, R.; Weibel, E. S. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). pp 609-612 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Self-consistent solutions of Vlasov's equations describing a plane boundary layer without shear are given. The currents within the layer are due to free and trapped electrons. The ion current is neglected since $m_e \ll m_i$. The free electrons and the ions are assumed Maxwellian at infinity. Field and density profiles are computed for E(x), B(x), $n_e(x)$, $n_i(x)$, and j(x) for different numbers of trapped electrons. (auth)

4246 COMPUTER SIMULATION OF rf PLASMA CONFINEMENT. Shohet, J. L. (Univ. of Wisconsin, Madison); Hatch, A. J. pp 617-620 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The particle-in-cell method of computer simulation was used to demonstrate rf confinement of low-density plasmas and to verify the Φ quasi-potential-well theory of rf confinement. Computations were made for a 2-dimensional central cross section of the quadrupole electric mode in a cubical resonant cavity. (auth)

4247 CONVECTIVE ION-SOUND MODES AND ANOMALOUS SKIN EFFECT. Santini, F. (EURATOM-CNEN, Frascati, Italy). pp 643-645 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The excitation of convective ion-sound modes in a sheared magnetic field is investigated. Their energy convection is proposed as a possible mechanism for the observed anomalous skin effect in tokamak discharges and compared with other mechanisms of transport. (auth)

Production

Refer also to abstract 4155.

4248 (CERN-73-10) THEORY OF IONIZATION GROWTH IN GASES UNDER PULSED AND STATIC FIELDS. Davies, A. J.; Evans, C. J. (European Organization for Nuclear Research, Geneva (Switzerland)). 10 Sep 1973. 122p. Dep. NTIS (U.S. Sales Only) $8.25.

An account is given of the statistical and nonstatistical theory of ionization growth in gases under pulsed and static fields. The five chapters deal with: basic ionization and transport processes; nonstatistical uniform field theory; temporal growth of ionization in fields distorted by space charge; statistical theory; and applications. 37 references. (DLC)

4249 ORIGIN OF "ENERGETIC" IONS FROM LASER-PRODUCED PLASMAS. Ehler, W.; Linlor, W.I. (Nasa, Ames Research Center, Moffett Field, California 94035). J. Appl. Phys. 44: No. 9, 4229-4231 (Sept 1973).

A fast-ion current peak, measured with an ion collector placed in the path of an expanding laser-produced plasma, was identified as carbon, nitrogen, and oxygen contaminants which originated from a tungsten target surface. (auth)

4250 IMPROVEMENTS IN OR RELATING TO THE GENERATION OF PLASMA. Cole, H. C. (to United Kingdom Atomic Energy Authority). British Patent 1,327,765. 22 Aug 1973. Filed date 17 Sep 1969. 4p.

A plasma system is described, including means for generating a magnetic field within a containment vessel. The apparatus comprises a plasma source, with an anode and a cathode within the containment vessel and spaced apart in a direction perpendicular to the magnetic lines of force of the confinement system. An inlet valve is provided for admitting gas into the region of the anode. Preferably the anode and cathode are concentric, with their axis parallel to the lines of force, and with the anode outside the cathode. The confinement system is preferably of the stellarator type, in which the containment vessel is toroidal and has solenoidal windings for generating a magnetic field parallel to the minor axis of the toroid. In this case the anode and cathode are arranged concentrically within the toroidal vessel, with their axis coincident with the minor axis of the toroid, and are enclosed except for an annular opening in the cathode facing the minor axis of the toroid. The enclosure is adapted for connection to a vacuum system, and a second inlet valve is provided for admitting material in the form of a powder into the region between the anode and cathode. Means are provided for applying a voltage across the anode and cathode so that the electric field produced is so related to the perpendicular magnetic field that the Larmor radius of electrons is smaller than the separation of the anode and cathode, while the Larmor radius of the ions is larger than the separation of the anode and cathode. (UK)

4251 NEUTRON PRODUCTION IN HIGH-ENERGY-DENSITY EXPLODED-WIRE Z-PINCH PLASMAS. Mosher, D.; Levine, L. S.; Stephanakis, S. J.; Vitkovitsky, I. M.; Young, F. (Naval Research Lab., Washington, DC). pp 419-421 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A high-power pulse generator was used to produce hot, dense plasmas from the explosion of fine deuterated polyethylene fibers. Neutron yields from the plasma exceed 10^{11} when CD_2-coated electrodes are employed. (auth)

4252 X-RAY SPECTROSCOPY OF THE ION POPULATION IN PLASMA PRODUCED AT THE SURFACE OF A PLANE MASSIVE TARGET BY INTENSE LASER IRRADIATION. Galanti, M.; Peacock, N. J. (Culham Lab., Abingdon, Eng.). pp 427-430 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Plasma produced at the surface of a $(CH_2)_n$ target irradiated by a 1.06-μm Nd laser with flux density up to 10^{12} W/cm^2 was the subject of quantitative x-ray-spectroscopic measurements. Electron temperatures up to 200 eV, and a mean electron density of 4×10^{20} cm^{-3} within 100 μm from the target surface, were measured from the spectral intensity of the recombination continuum into C^{6+} and C^{5+} ions. (auth)

4253 EFFECT OF THE ELECTRON FREE-STREAMING LIMIT ON LASER COMPRESSION. Ashby, D.E.T.F.; Christiansen, J. P. (Culham Lab., Abingdon, Eng.). pp 431-434 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A one-dimensional two-fluid Lagrangian code was used to calculate the effect of limiting the heat flux to that set by the free-streaming limit. The results suggest that, with 10-μ radiation, the thermonuclear yield is drastically reduced when the free-streaming factor $\alpha \gtrsim 1$. (MOW)

4254 INVESTIGATION OF FAST ELECTRONS IN A LASER-PRODUCED PLASMA BY X-RAY MEASUREMENTS. Eidmann, K.; Sigel, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 435-438 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Measurements of the x-ray emission from a Nd-laser-produced deuterium plasma show the following results: (1) an enhanced emission of energetic x rays indicating an excess of fast electrons in the tail of the electron distribution function, (2) runaway electrons, which leave the plasma and produce x rays at the wall of the target chamber, and (3) isotropic x-ray emission from the target indicating that the energetic tail of the electron velocity distribution function is essentially isotropic. (auth)

4255 X-RAY AND UV EMISSION OF LASER-PRODUCED PLASMAS. Nagel, D. J.; Barr, O. C.; Burkhalter, P. G.; Doschek, G. A.; Dozier, C. M.; Feldman, U.; Klein, B. M.; McCrary, J. H.; McMahon, J. M.; Whitlock, R. R. (Naval Research Lab., Washington, DC). pp 447-450 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

K, L, and M x-ray spectra and uv spectra emitted by laser-produced plasmas indicate which ionization stages exist in the plasmas. Data on the total intensity, duration, and size of the x-ray source were also obtained. (auth)

4256 INITIATING IMPULSE NUCLEAR FUSION REACTION BY MEANS OF DT MIXTURE COMPRESSING BY THE SHELL HEATED WITH A STRONG RELATIVISTIC ELECTRON BEAM. Rudakov, L. I. (Inst. of Atomic Energy, Moscow); Samarskii, A. A. pp 487-490 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Spherical compression of a D-T plasma by relativistic electron beams was calculated using two-component gas dynamic equations with allowance for electron viscosity and heat conductivity but not taking into account the radiation. Alpha particle energy was calculated over the total volume of the D-T mixture. The initial parameters and some variants of the calculation are given. (MOW)

4257 ENERGY-SPECTRUM MEASUREMENT OF RELATIVISTIC ELECTRONS IN EXPERIMENTS ON INTERACTION OF HIGH-CURRENT BEAM WITH PLASMA. Gosteva, T. S.; Dubovoci, L. V.; Zablotskaya, G. R.; Ivanov, B. A.; Chernobrovin, V. I. (Scientific Research Inst. of Electrophysical Apparatus, Leningrad). pp 507-510 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Distribution processes of an intense beam of 50-kA relativistic electrons in neutral gases are studied. Conditions of plasma formation in this case are determined, and an energy spectrum of accelerated electrons is measured. (auth)

4258 EXPERIMENTS ON PRODUCING THE HIGH-β PLASMA BY LONGITUDINAL SHOCK WAVES. Es'kov, A. G.; Zolotovskii, O. A.; Kurtmullaev, R. Kh.; Lauhin, Ya. N.; Malyutin, A. J.; Markin, A. J.; Semenov, V. N. (Inst. of Atomic Energy, Moscow). pp 599-602 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Plasma heating and motion under the action of a piston formed of elongated poloidal magnetic lines of force are investigated. First of all, possibilities of reaching large values of nT, β, T were of interest, these being urgent problems in the program on toroidal plasma devices. The system was simultaneously examined as an induction injector of a hot plasma for the scheme of a θ-pinch with liner. Finally, the plasma and magnetic field behavior at the controlled lines of force reconnection is of interest for astrophysical applications. (auth)

4259 PRODUCTION OF PLASMAS BY LONG-WAVELENGTH LASERS. Dawson, J. M. (to United States Atomic Energy Commission). US Patent 3,764,466. 9 Oct 1973. Filed date 1 Apr 1971. 20p.

A long-wavelength laser system for heating low-density plasma to high temperatures is described. In one embodiment, means are provided for repeatedly receiving and transmitting long-wavelength laser light in successive stages to form a laser-light beam path that repeatedly intersects with the equilibrium axis of a magnetically confined toroidal plasma column for interacting the laser light with the plasma for providing controlled thermonuclear fusion. Embodiments for heating specific linear plasmas are also provided. (Official Gazette)

Stability

Refer also to abstracts 4139 and 4345.

4260 (CEA-CONF-2385) CORRELATION BETWEEN THE NATURE OF VELOCITY-SPACE ANISOTROPY AND THE FREQUENCY OF ELECTROSTATIC ELECTRON-CYCLOTRON INSTABILITIES. Jacquinot, J.; Leloup, C.; Pellat, R.; Abdalla, M.; Chanteur, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). [nd]. 4p. (CONF-730906-11). Dep. NTIS (U.S. Sales Only) $3.00.

From 11th international conference on phenomena in ionized gases; Prague, Czechoslovakia (10 Sep 1973).

Both laboratory and outer space plasmas exhibit a great variety of unstable cyclotron modes usually characterized by a well-defined frequency domain. It is shown that it is possible, in most cases, to infer qualitative information on the anisotropy of the distribution function by the simple knowledge of the frequency spectrum of the anomalous radiation emitted by the plasma. The characteristics of known instabilities are first reviewed, then an instability requiring a positive df/dE at low energy ("loss cone") and a small amount of cold plasma was discussed. (MOW)

4261 EQUILIBRIUM OF A TOROIDAL PLASMA INSIDE TWO CONCENTRIC CONDUCTING SHELLS. Hosea, J.C.; Bobeldijk, C. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 8, 1329-1336 (Aug 1973).

The equilibrium analysis appropriate to tokamak geometry is extended to the case of two conducting shells surrounding the plasma column: a thick outer shell generally used in tokamaks to equilibrate the plasma hoop and pressure forces and a thin inner shell corresponding to the vacuum vessel or liner. Analytic expressions are derived for selected cases to demonstrate the influence of $\beta_\theta + l_i/2$ and B_v on the increment of displacement omitted by the thin casing solution for the outer shell under conditions for which the inner shell has no influence. For quickly changing equilibria, the inner shell (vessel) plays a significant role and its effect on the equilibrium position as well as on magnetic probe measurements of this position and $\beta_\theta + l_i/2$ are derived. (auth)

4262 STABILITY OF A FINITE β, L = 2 STELLARATOR. Freidberg, J.P. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Fluids 16: No. 8, 1349-1358 (Aug 1973).

The stability of an infinitely long, high β, $l = 2$ stellarator is investigated. The calculation is carried out by using the new scyllac expansion in the sharp boundary ideal magnetohydrodynamic model. It is found that for any given size $l = 2$ field and mode number m, an infinite but discrete set of wavenumbers k exist for which the plasma is unstable to all β; that is, the critical β equals zero. These modes can be described as long wavelength interchanges. Thus, with regard to sharp boundary stability, $l = 2$ is less desirable than $l = 1$ for the basic scyllac field, and in addition does not offer any particular advantage over $l = 0$ as a sideband field required for toroidal equilibrium in the $l = 1$ configuration. (auth)

4263 ELECTRON SPATIAL DISTRIBUTIONS AND LOSS RATES IN EXPERIMENTALLY ACHIEVED ASTRON E-LAYERS. Humphries Jr., S. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 16: No. 8, 1359-1365 (Aug 1973).

Experimental results are presented which show that stable astron E layers achieved to date can be described by a diffusion theory based on collisions with the background gas. The E layer is found to be primarily composed of the fundamental radial and axial modes. Time-resolved measurements of the radial density distribution are described. Decay rates are shown to be approximately classical. Axial decay rates can sometimes be strongly influenced by self-forces resulting in a linear rather than exponential decay of a fundamental mode E layer. The rapid initial decay of neutralized E layers during multiple pulse experiments is explained in terms of the theory by the presence of high order axial modes of injection. (auth)

4264 DECAY OF POLOIDAL ROTATION IN A TOKAMAK PLASMA. Stix, T.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 8, 1260-1267 (Aug 1973).

Radial electric fields may be built up in a tokamak by several mechanisms such as nonambipolar particle transport or loss, or the inhomogeneous deposition of electric charge which occurs as a result of the injection of fast neutral atoms. The initial effect of the radial fields is to produce a poloidal rotation of the plasma. Such rotation, however, subjects the moving elements of the plasma to energy dissipation by magnetic pumping, which damps the rotation in a period of the order of the ion-ion collision time. The problem is analyzed for the "plateau" and "banana" regimes by applying the drift kinetic equation, with a simple relaxation collision term, to a slab-model low-β plasma. The calculation may be more generally applied to the problem of momentum dissipation for any low-β long-mean-free-path plasma in a periodic or stochastic magnetic field. (auth)

4265 NONLINEAR STABILIZATION OF OSCILLATING TWO-STREAM INSTABILITY. Nishikawa, K.; Lee, Y.C. (Department of Physics, University of California, Los Angeles, California 90024); Kaw, P.K. Phys. Fluids 16: No. 8, 1380-1381 (Aug 1973).

It is shown that the basic nonlinear effect associated with the oscillating two-stream instability is a downshift of the natural frequencies of electron plasma waves. As a result, conversion of this instability to a decay instability can take place. (auth)

4266 INTERACTION BETWEEN AN INTENSE ELECTROMAGNETIC WAVE AND A PLASMA. Galeev, A. A.; Laval, G.; O'Neil, T.; Rosenbluth, M.; Sagdeev, R. Z. (Inst. of High Temperature, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 3, 973-989 (Sep 1973). (In Russian).

A linear theory of parametric instabilities in an inhomogeneous plasma is considered. The linear amplification coefficients are calculated for small perturbations produced during reverse parametric scattering and parametric absorption of an intense electromagnetic wave in a plasma. Nonlinear models are proposed that describe the reverse parametric scattering process. In the case of "soft inclusion" of the instability for describing relaxation of radiation penetrating the plasma, the quasilinear theory is sufficient as a rule. The relaxation length of the incident electromagnetic wave is estimated in the case of "hard" inclusion of the instability. (auth)

4267 NUMERICAL STUDY OF HYDROMAGNETIC STABILITY USING THE FINITE-ELEMENT METHOD. Boyd, T. J. M.; Gardner, G. A.; Gardner, L. R. T. (Univ. of Wales, Swansea). Nucl. Fusion; 13: No. 5, 764-766(Oct 1973).

The finite-element method to discuss hydromagnetic stability is emphasized. The analysis was confined to a linear pinch surrounded by a vacuum. The plasma is a cylindrical column of

circular cross section surrounded by a concentric conducting wall. The instability growth rates are described for several parameters. (MOW)

4268 **DECAY INSTABILITY OF MAGNETOHYDRODYNAMIC OSCILLATIONS IN A PLASMA CYLINDER IN THE FIELD OF A DIRECT MAGNETOSONIC WAVE. Elfimov, A. G.; Nekrasov, F. M. (Sukhumi Physico-Technical Inst., USSR). Nucl. Fusion; 13: No. 5, 653-659(Oct 1973).**

The decay instabilities of the hydromagnetic oscillations in a plasma cylinder placed in the field of a direct magnetosonic wave $H_Z = \tilde{H}_0 I_0 (k_0 r) \cos \Omega_0 t$ (I_0 is the Bessel function, k_0 is the radial wave number, $\Omega_0^2 = k_0^2(c_A + c_s^2$ and $\tilde{H}_0$ is the amplitude of the high-frequency field) are studied. Instability growth rates are derived for decay in cases where the result is the excitation of short-wave Alfvén and slow magnetosonic oscillations. Calculations were carried out for various distributions of the field of the background wave over the cylinder cross section: $k_0 a \ll 1$; $k_0 a = 2.405$; a is the radius of the cylinder. The growth rates are determined by formulas of the type $\gamma = \Omega_0 A \tilde{H}_0/H_0$, where H_0 is the strength of the static field, A is a coefficient less than or of the order of unity, depending on the type of decay, the plasma parameters and the wave numbers for the excited waves. Formulas are presented for the determination of the threshold amplitudes for excitation of the instabilities. The possibility of using these instabilities for plasma heating is briefly discussed. (auth)

4269 **QUASI-LINEAR THEORY OF DISSIPATIVE ION-ACOUSTIC INSTABILITY. Kovpik, O. F.; Onishchenko, I. N. (Physical-Technical Inst., Kharkov). Nucl. Fusion; 13: No. 5, 715-717(Oct 1973).**

The instability of an electron beam in a plasma with a hot electron component is considered. The presence of the beam means that waves with negative energy may be propagated through the plasma. If the pair collision frequency or the collisionless Landau damping decrement is greater than the beam growth rate, a dissipative instability is created in the plasma/cold beam system. They indicate the conditions under which the dissipative ion-acoustic instability originates, together with its growth rate and threshold excitation current. On the basis of quasi-linear theory equations, they derive the noise level created by development of the instability and also the distribution of the energy lost by the beam in terms of degrees of freedom (increase in the effective beam temperature and heat-up of electrons and plasma ions). (auth)

4270 **NONLINEAR EFFECT IN A PLASMA. Tavzes, R.; Cercek, M. (Univ. Ljubljana, Yugoslavia). Fizika (Zagreb); 5: No. 3, 125-129(Aug 1973).**

Experimental results were obtained that show a collisional drift instability in a bounded plasma column behaves like a classical Van der Pol oscillator. The plasma is produced by microwave heating at ECR and plasma density is varied periodically by amplitude modulation of the hf power at a modulation frequency close to the instability frequency. The experimental results are in good agreement with a behavior of a Van der Pol oscillator for drive frequencies near the center frequency of the oscillator. (auth)

4271 **STABILITY AND HEATING EXPERIMENTS ON THE ATC TOKAMAK. Bol, K.; Cecchi, J. L.; Daughney, C. C.; Ellis, R. A. Jr.; Eubank, H.; Furth, H. P.; Jacobsen, R. A.; Johnson, L. C.; Mazzucato, E.; Stodiek, W. (Princeton Univ., NJ). pp 18-21 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).**

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The ATC experiment was designed to provide information about two major areas of tokamak research: non-Ohmic heating and MHD stability. The MHD stability of the precompression discharge, some new results on the nature of the disruptive instability that occurs in all tokamaks at high-gas-filling pressure, and some new plasma-heating experiments now in progress are described. (auth)

4272 **PLASMA COLUMN PERTURBATIONS PRECEDING TO DISRUPTIVE INSTABILITY IN T-6 TOKAMAK. Vlasenkov, V. S.; Krupin, V. A.; Leonov, V. M.; Merezhkin, V. G.; Mukhovatov, V. S. (Inst. of Atomic Energy, Moscow). pp 55-58 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).**

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Plasma-column perturbations occurring just before the negative voltage spike in the T-6 tokamak were investigated. Typical parameters of the hydrogen discharge are the following: $P_0 = 1.5 \times 10^{-4}$ torr, $H_0 = 5$ to 10 kG, $J = 40$ kA, and $q(a) = 2$ to 4. The oscillograms are described. (MOW)

4273 **VACUUM BUBBLES IN TOKAMAK PLASMAS. Kadomtsev, B. B.; Pogutse, O. P. (Inst. of Atomic Energy, Moscow). pp 59-62 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).**

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The kink instability of a tokamak plasma is considered without a restriction imposed by the linear approximation. It is shown that helical modes develop into bubbles (a kind of plasma-free helical snakes penetrating under the plasma surface). (MOW)

4274 **EFFECT OF PARABOLIC CURRENT ON STABILITY OF MHD EQUILIBRIUM IN TOKAMAK WITH NONCIRCULAR CROSS SECTION. Grelot, P.; Weisse, J. (CEN, Grenoble, France). pp 79-82 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).**

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The stability limit of the MHD equilibria is given by Mercier's criterion calculated along the magnetic axis of the configuration. In the comparison of the stability zones, the plasma cross section is taken as constant. This cross section is normalized to: the small radius of the equivalent circular tokamak with a unit value, so that the large radius is directly related to the aspect ratio. (auth)

4275 **MHD MODAL ANALYSIS OF TOKAMAK-LIKE PLASMA WITH VARIOUS CURRENT-DENSITY PROFILES. Grossmann, W.; Ortolani, S. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 83-86 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).**

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

An analysis of MHD stability for a cylindrical tokamak plasma with realistic current density profiles is presented. The results show that the various current profiles lead to stability criteria significantly different from those of earlier considerations. (auth)

4276 **KINK INSTABILITIES IN HIGH-β TOKAMAKS AND BELT PINCHES. Freidberg, J. P.; Haas, F. A.; Marder, B. M. (Los Alamos Scientific Lab., NM). pp 87-90 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).**

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

It is shown that kink instabilities in a high-β sharp boundary tokamak ($\beta \sim a/R$) are strongly destabilized by toroidal effects. For either $\beta \sim a/R$ or $\beta \sim 1$ (Belt Pinch) moderate ellipticity has a stabilizing effect on kink modes whereas large ellipticity is strongly destabilizing. (auth)

4277 **STABILITY CRITERIA FOR GENERAL MHD EQUILIBRIA. Lortz, D. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 91-94 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).**

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

It is shown that the energy variation can be estimated by an integral containing only surface quantities, thus leading to a one-dimensional problem that can be treated like the cylindrically symmetric case. The result is a new sufficient stability criterion that admits a nonvanishing current density on the magnetic axis. (auth)

4278 **STABILITY OF TRAPPED-PARTICLE AND DRIFT-WAVE NORMAL MODES WITH ESTIMATES OF ANOMALOUS TRANSPORT. Horton, W.; Ross, D. W. (Univ. of Texas, Austin). pp 95-98 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).**

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Results are given for the domain of instability in tokamaks for normal modes of the dissipative trapped-particle modes and the collisionless drift waves. Estimates of the anomalous transport are given. (auth)

4279 **CRITICAL β FOR QUADRUPOLE CONFIGURATIONS. Rebhan, E.; Lortz, D. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 135-138 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).**

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A sufficient stability criterion is applied to straight quadrupole configurations. Defining β = (total internal energy)/(total magnetic energy), complete MHD stability can be achieved up to $\beta \simeq 1$ if the poloidal current is sufficiently large. The results obtained can qualitatively be transferred to toroidal configurations. (auth)

4280 OBSERVATION OF DRIFT INSTABILITY DUE TO PARTICLE TRAPPING IN A CORRUGATED GEOMETRY. Deschamps, P.; Gravier, R.; Renaud, C.; Samain, A. (CEN, Fontenay-aux-Roses, France). pp 143-146 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A drift instability was observed in a corrugated shearless field in ODE under conditions where the bounce frequency for electrons is larger than either the wave frequency or the effective collision frequency. The wave retains features of the trapped particle instability. Diagrams showing the fluctuation amplitudes and the drift instability amplitudes are described. (MOW)

4281 DYNAMIC STABILIZATION OF A PLASMA IN STELLARATOR AND TOKAMAK MACHINES. Demirkhanov, R. A.; Kirov, A. G.; Zharikov, V. N.; Malikh, N. I.; Ruchko, L. F.; Astapenko, G. I.; Zhdanov, V. A. (Inst. of Physics and Tech., Sukhumi, USSR). pp 169-172 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Results are given of experimental investigations of plasma dynamic stabilization in stellarator (R-0) and tokamak (RT-4) machines at small q by means of an hf quadrupole magnetic field and an hf magnetic field of zero mode type. (auth)

4282 STUDY OF DYNAMIC STABILIZATION CONDITIONS OF TOROIDAL DISCHARGE IN MODULATED LONGITUDINAL MAGNETIC FIELD. Vasilevskii, M. A.; Komar, E. G.; Roife, I. M.; Seredenko, E. V. (Scientific Research Inst. of Electrophysical Apparatus, Leningrad). pp 177-180 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The modulation of a longitudinal magnetic field for dynamic stabilization of the Toloscope device is described. Quasi-constant current pulses with duration of about 100 μsec and alternating magnetic field pulses of about 250 μsec were switched on at a flat part of the pulse of the quasi-constant magnetic field. The data are presented and discussed. (MOW)

4283 INVESTIGATION OF INSTABILITY OF COLLISIONAL PLASMA IN PR-6 MIRROR TRAP. Kanaev, B. I.; Yushmanov, E. E. (Inst. of Atomic Energy, Moscow). pp 235-238 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The previous experiments in PR-6 device have revealed an instability identified tentatively as the drift-cone mode. New experiments involving shf heating of electrons have confirmed the close tie between the instability and T_e, thus proving the validity of the earlier concept. It is experimentally shown that the instability can be stabilized by slight repopulation of the cold region of the ion distribution function through transverse heating of a small fraction of the electrons. (auth)

4284 PLASMA CONFINEMENT IN PRESENCE OF FEEDBACK SYSTEM IN OGRA-3 DEVICE. Chuyanov, V. A.; Likhtenshtein, V. Kh.; Panov, D. A.; Zhil'tsov, V. A.; Scherbakov, A. G. (Inst. of Atomic Energy, Moscow). pp 243-246 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

In the simple mirror magnetic trap, the one-electrode feedback system increases a flute instability threshold only within a limited range of plasma densities. The feedback system with two electrodes displaced in azimuth by 90° removes this limitation. The density obtained with the feedback "on" exceeds the flute instability threshold by more than a factor of ten. At the highest density achieved, plasma losses related with residual oscillations are observed. (auth)

4285 STABILITY, RADIATION LOSSES, AND EQUILIBRIUM IN THE GARCHING BELT PINCH ISAR IV. Krause, H.; Wilhelm, R.; Zwicker, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 273-276 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Stability for m = 1 modes at $q \lesssim 1$ is investigated. For $q < 1$, clear m = 1 modes are observed, while for $q \approx 1$, stability is much better. The influence of pre-ionization and of oxygen-impurity cooling on the temperature behavior is measured and compared with calculations. (auth)

4286 ASPECTS OF DYNAMIC STABILIZATION OF HIGH-BETA PLASMAS. Gruber, O.; Becker, G.; Herold, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 285-288 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Dynamic stabilization of an unstable toroidal screw pinch by $\tilde{B}_z$ is demonstrated. Working in resonance with the m = 0 mode, the $\tilde{B}_z$ amplitude necessary for stabilization is reduced. The plasma heating rate inherent in the $\tilde{B}_z$ stabilization scales with the square of the growth rate and is independent of the stabilizing frequency. (auth)

4287 TOROIDAL Z-PINCH PROGRAM AT LOS ALAMOS. Baker, D. A.; Burkhardt, L. C.; Di Marco, J. N.; Forman, P. R.; Haberstich, A.; Howell, R. B.; Karr, H. J.; Mann, L. W.; Phillips, J. A. (Los Alamos Scientific Lab., NM). pp 293-296 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Experimental and theoretical studies of the diffuse z pinch are described. The dependence of stability on B_z field magnitude, B_z reversal, and I_z crowbar are discussed. (auth)

4288 DYNAMICAL CONTROL OF THETA-PINCH PLASMA. Itagaki, T.; Saito, K.; Shiina, S.; Yokoyama, K.; Yoshimura, H. (Nihon Univ., Tokyo). pp 319-322 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The effect of suppression of ballooning motion by an hf magnetic field is investigated in a modified theta-pinch plasma. The field configuration of the theta pinch is deformed by means of a copper sheet, which is rolled around the discharge tube and has a longitudinal cut. (auth)

4289 THEORY OF ION-SOUND RESISTIVITY. Wesson, J.; Sykes, A. (Culham Lab., Abingdon, Eng.). pp 457-460 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The physical behavior is described as follows. The turbulence grows at a rate determined solely by the growth rate of the ion-sound instability. This growth rate is determined by the combined effect of the destabilizing electron resonance and the stabilizing ion resonance. The nonlinear modification of the ion-damping contribution to the growth rate takes a particularly simple form in that the stabilizing effect of the turbulence appears as a virtual increase in the ion temperature. The calculations are described. (MOW)

4290 ANOMALOUS RESISTIVITY AND STABILIZATION OF ION-SOUND INSTABILITY. Biskamp, D.; Chodura, R.; Dum, C. T. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 461-464 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The stabilization mechanism of the ion-acoustic instability is investigated by computer simulation. For a wide range of initial parameters, and either constant current or constant ratio of current to electron thermal velocity, stabilization occurs by formation of a high-energy ion tail. (auth)

4291 SPATIAL GROWTH PROPERTIES OF PARAMETRIC AND BACKSCATTERING PLASMA INSTABILITIES. Fried, B. D. (Univ. of California, Los Angeles); Schmidt, G.; Gould, R. W. pp 477-480 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma

physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Simple general arguments are used to show that, for instabilities resulting from the coupling of two weakly damped linear modes with oppositely directed group velocities, such as the various parametric instabilities, there exists a range of coupling strengths (pump power in the parametric case) for which the instability is convective; above this range the system is absolutely unstable. The ratio of absolute and convective instability thresholds is large whenever the damping lengths of the linear uncoupled modes have very disparate values. (auth)

4292 STATISTICAL ANALYSIS OF THE HIGH-FREQUENCY BURSTS OF A BEAM—PLASMA EXPERIMENT. Cabral, J. A. C.; Silva, M. E. F. (Instituto Superior Tecnico, Lisbon). pp 525-528 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The probability that an electron-cyclotron burst has to attain a certain amplitude is studied. These measurements suggest that the complete field structure of the cyclotron instability travels along the experimental chamber. (auth)

4293 DECAY INSTABILITY OF LANGMUIR AND ION-SOUND OSCILLATIONS IN PLASMA—BEAM SYSTEM. Matsiborko, N. G.; Onishchenko, I. N.; Oraevskii, V. N.; Shapiro, V. D.; Shevchenko, V. I. (Physical-Technical Inst., Kharkov). pp 537-541 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A nonlinear theory of decay instabilities in beam—plasma systems is discussed. The results were obtained by means of computer simulation. (MOW)

4294 STABILIZATION OF VOLUME FLUTE MODES IN MIRROR MACHINES BY THE ELECTRODE FEEDBACK SYSTEM. Arsenin, V. V. (Inst. of Atomic Energy, Moscow). pp 625-627 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Volume flute oscillations of a finite plasma cylinder are investigated. It is shown that the instability can be suppressed by the feedback system that controls the perturbation field outside the magnetic mirrors. (auth)

4295 LOW-FREQUENCY STABILITY THEORY OF AXISYMMETRIC TOROIDAL PLASMAS. Connor, J. W.; Hastie, R. J. (Culham Lab., Abingdon, Eng.). pp 631-634 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Axisymmetric toroidal geometry is considered with vacuum magnetic fields. The problems encountered by earlier treatments are essentially caused by the conflict between the periodicity constraints implied by the toroidal geometry and the $k_{\|}a_{i} \sim \epsilon$ condition, in strongly sheared magnetic fields. A resolution of this conflict is proposed, and a consistent solution of the Vlasov—Poisson equations is obtained. (MOW)

4296 INFLUENCE OF HIGH-FREQUENCY ELECTROSTATIC OSCILLATIONS ON THE LOW-FREQUENCY PLASMA INSTABILITY. Kopecky, V. (Inst. of Plasma Physics, Prague). pp 635-638 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The influence of the principal mode of hf electrostatic oscillations on the flute instability of an inhomogeneous plasma is studied. Instability conditions in a collisional as well as collisionless plasma are obtained, and it is demonstrated that in certain circumstances the beam-excited hf oscillations can stabilize the flute instability. (auth)

4297 NUMERICAL INVESTIGATION OF THE STABILITY CRITERION FOR INHOMOGENEOUS NON-MAXWELLIAN VLASOV EQUILIBRIA. Cuperman, S.; Tzur, I. (Univ of Colorado, Boulder). pp 650-653 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The existence of an instability criterion for inhomogeneous non-Maxwellian Vlasov equilibria is demonstrated with the aid of numerical integration techniques. (auth)

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Refer also to abstracts 2822 and 3681.

4298 (CEA-CONF-2397) FIRST RESULTS ON T.F.R. Rebut, P. H.; Bariaud, A.; Breton, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). 1973. 17p. (CONF-730705-23). Dep. NTIS (U.S. Sales Only) $3.00.

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973).

A short description of the TFR device is given along with first results obtained since the start of the experiment (March 1973). The maximum values of the current and the toroidal field were 200 kA and 40 kG. (MOW)

4299 (CONF-730324-, pp 40-43) ADDITION OF THORIUM TO A FUSION REACTOR BLANKET. LaVergne, G. (Univ. of Quebec). 1973.

From ANS Niagara—Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

The use of excess neutrons in breeding blankets for the fast fission of thorium-232 is discussed. The tritium breeding ratio, neutron absorption in thorium, and thorium fast fission rates are discussed. (MOW)

4300 (LA-UR-73-910) DESIGN OPTIONS AND TRADE-OFFS IN SUPERCONDUCTING MAGNETIC ENERGY STORAGE WITH IRREVERSIBLE SWITCHING. Laquer, H. L.; Lindsay, J. D. G.; Little, E. M.; Rogers, J. D.; Weldon, D. M. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. 21p. (CONF-731102-1). Dep. NTIS $3.25.

From symposium on technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1973).

A program is presently under way at Los Alamos to determine how superconducting magnetic energy storage in conjunction with normal-going superconducting switches can be made to deliver the energies of the order of 200 MJ that will be needed for plasma compression in a pulsed θ-pinch scientific feasibility experiment. After a review of the circuit configurations, the properties of commercially available and of some developmental superconductors relevant to both the energy storage coil and to the switch are discussed. Critical current densities at low fields and stability requirements both with respect to rapidly changing external fields and to self fields are of particular importance in determining optimum operating fields and temperatures. The trade-off between eddy current losses in the stabilizing material and the need for coil protection if a coil normalcy should occur is described. Problems in potting or other forms of mechanical stabilization for both superconducting elements are pointed out. The experimental phenomenon of an only partially normalized superconducting switch is described as are the conditions for attaining fully normal resistance. A number of cryogenic engineering problems are discussed briefly, including the requirements for plastic, non-conducting dewars and for a staged refrigerator to re-cool the switch in the most economical manner. Results of 20-kJ energy-transfer experiments into both resistive and inductive loads are given and the design parameters are reported for a 300-kJ experiment now under construction. (auth)

4301 EXPERIMENTAL DETERMINATION OF THE CHARACTERISTIC OF A PLASMA FOCUS. Rapp, H. (Univ., Stuttgart). (1973). vp. (In German).

From spring meeting of the German Physical Society: pulse physics, plasma physics and gas discharges, quantum optics; Berlin, Germany (9 Apr 1973).

The relation between the neutron yield, the stored energy, and the deuterium working gas pressure, as well as the length of the electrode is investigated. This relation is called the "characteristic" of a plasma focusing device. It shows the relation between "output" and "input" of a fusion device as a function of several operating parameters. The experiments were carried out at the NESSI facility in the energy range between 20 and 45 kJ with C = 225 μF, using the Mather-type accelerator with a diameter of 66 × 125 mm. (GE)

4302 COAXIAL PLASMA GUN WITH OUTER ELECTRODE OF CAGE STRUCTURE NEAR FAST ACTING VALVE. Kawahata, K.; Miyamoto, K. (Nagoya Univ., Japan). Jap. J. Appl. Phys.; 12: No. 5, 774-775(May 1973).

In order to obtain a highly ionized plasma, a coaxial gun with an expansion chamber (40 cm^{ϕ} × 60 cm length) was prepared, through which the produced plasma is guided into the stellarator device and the neutral gas is discriminated to enter the device. The coaxial plasma gun is energized by a 14-μF capacitor bank with the voltage of 15 kV. The neutral gas is injected from the fast acting valve to the inter-electrode space of the gun during about 800 μsec after triggering the fast-acting valve. The discharge current streams during about 50 μsec. Therefore, many neutral particles are mixed in the produced plasma because of the difference of these time durations. To prevent these neutral particles from mixing in the plasma, the outer electrode of the gun near the fast acting valve is made to be a cage structure which consists of eight copper rods. (auth)

4303 REVIEW OF FUSION-FISSION (HYBRID) CONCEPTS. Leonard, B. R. Jr. (Battelle Pacific Northwest Labs., Richland, WA). Nucl. Technol.; 20: No. 3, 161-178(Dec 1973).

The 14-MeV neutrons from a controlled DT fusion plasma can potentially be used to produce neutron source multiplication and energy multiplication through fission in a heavy-element blanket surrounding the fusion plasma. Concepts which involve the use of fusion-produced neutrons to ultimately produce fission are generically classed as fusion–fission hybrids. The conceptual purposes of hybrids can be many and varied: to relax the fusion plasma confinement conditions to allow further development of fusion power; to breed fissile material for fission reactors; as a subcritical fission lattice which is more energetic than the pure fusion concept; and the ultimate reduction of radioactive heavy element waste to fission product. The concept of a hybrid is based on an analysis of the neutronic behavior of the blanket. The status of studies of the neutronics analyses of proposed hybrids was reviewed. These results were used to determine the need for further development of hybrid technology. (auth)

4304 CURRENT-SHELL DYNAMICS IN A PULSED ELECTRODYNAMIC PLASMA ACCELERATOR. Val'kov, Yu. A.; Skvortsov, Yu. V. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 10, 1659-1669(Apr 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 10, 2088-2104(Oct 1972).

The acceleration of a current shell in a coaxial accelerator is investigated. The outer electrode has an internal diameter of 10 cm and is 40 cm long; the inner electrode is 3.2 cm in diameter and 56 cm long. The electrodes are copper. Openings for the admission of hydrogen are located in the inner electrode at 37 cm from the face of the accelerator. A pulsed thermal valve with selectable delay time allows the introduction of $\sim 1.5 \times 10^{19}$ hydrogen atoms into the accelerator gap. A condenser bank (5.4 μ F) charged to −25 kV is connected to the accelerator electrodes. The discharge current reaches 114 kA; the half-period is 3.4 μsec. The hydrogen pressure in the gap before the discharge is ~1 mm Hg. The measurements enable one to plot the distribution of magnetic and electric fields in the accelerator gap as a function of time, to determine the dimensions of the current shell and the shape of the line current, to find the time and place of closed current and lead plasmoid formation, and to determine the transition time from an anode potential drop to a cathode drop. These data indicate that a narrow current bridge is formed in the initial stage; the width corresponds to the longitudinal dimensions of the gas cloud. The plasma acceleration then observed is accompanied by a current distribution along the electrodes and an increase in longitudinal dimensions of the bridge. Plasma acceleration ceases with the appearance of closed currents in the system. Interferometer and spectroscope measurements make it possible to plot the distribution of charged-particle densities in the current shell in the accelerator gap as a function of time and to estimate the plasma temperature and impurity localization. Analysis of the experimental data leads to the following conclusions: In electrodynamic accelerators with pulsed admission of hydrogen, the formation of a current shell occurs with the formation of an ionization front, and not in accordance with the "snowplow" or "stable current bridge" models. The spatial distribution of the density and the width of the current shell are explained by the existence of the ionization front. Ion currents play an important part in plasma acceleration. Where a longitudinal electric field exists, it owes its origin to the Hall effect. (auth)

4305 NUCLEAR DATA FOR THERMONUCLEAR INSTALLATIONS. Chernilin, Yu. F. (Inst. of Atomic Energy, Moscow). pp 25-39 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The engineering and physical problems of design of thermonuclear installations involve a detailed investigation of the interaction between the fusion neutrons and the blanket materials. The most important processes which take place within the blanket are reviewed: tritium breeding, nuclear heating, and radiation damage. (auth)

4306 COAXIAL PLASMA INJECTOR WITH PREIONIZATION. Zavada, P. I.; Kalmykov, A. A.; Tereshin, V. I.; Chebotarev, V. V. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 11, 1817-1821(May 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 11, 2326-2333(Nov 1972).

The operation of a coaxial plasma injector with a supplementary induction electric field produced by a single-turn coil near the gas input is investigated. For a sufficiently large supplementary field the basic discharge in the injector is uniform and symmetric, and the reproducibility of the plasmoid parameters is improved. Discharge symmetrization in the injector is accompanied by an increase in the total energy of the plasma flux as a result of the increase in the fast plasmoid energy. The supplementary field also reduces the number of high-energy impurity ions in the plasma. (auth)

4307 FRINGE FIELDS FROM THE SOLENOIDS OF THERMONUCLEAR DEVICES. Timonin, A. M. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). Sov. Phys. Tech. Phys. (Engl. Transl.); 17: No. 11, 1796-1798(May 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 11, 2295-2299(Nov 1972).

The magnetic fields produced by the currents in intercoil connections of solenoids are analyzed. When there are few turns per unit length (as is necessary when the solenoid is fed from a low-voltage source, e.g., a homopolar generator), these fields, which are transverse to the primary field, reach an unsatisfactory level for thermonuclear devices. When the coils are connected with alternate polarity the average transverse field vanishes along the axis; this is also true in the limiting case of a solenoid consisting of single-turn coils. The periodic transverse field of such a solenoid is also evaluated. (auth)

4308 AZIMUTHAL SYMMETRY IN A COAXIAL PLASMA INJECTOR. Burtsev, V. A.; Litunovskii, V. N.; Nadgornaya, M. P. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 10, 1670-1676(Apr 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 10, 2105-2114(Oct 1972).

The results of an experimental study of azimuthal symmetry are presented for a pulsed plasma injector with an electrode diameter ratio close to unity, with shaped gas injection, and prior ionization of the gas by an induction electric field. It is observed that current layers in the interelectrode space of the injector maintain azimuthal closure during the entire existence of the discharge, regardless of the gas distribution at the time the voltage is applied to the electrodes. (auth)

4309 STRAIGHT HELICAL HELIOTRON FIELD. Uo, K. (Kyoto Univ.). Nucl. Fusion; 13: No. 5, 661-664(Oct 1973).

The general expression of the $l = 2$ straight helical heliotron field is obtained by integrating Biot–Savart's formula after expanding the integrand. Solving the differential equation of the line of force, a general expression for the magnetic surfaces, which is in good agreement with the results of a computer calculation up to the separatrix, is obtained. The rotational transform and the shear of this field are calculated as functions of the average radius of the magnetic surface. For a certain range of α^*, the ratio of the longitudinal field produced by the B_z coil to the longitudinal component of the field produced by the helical coil, the field cannot form a closed magnetic surface. The width of this range, the forbidden zone, is a function of $\gamma = 2\pi a/p$, where a is the radius of the helical winding and p is the pitch. For small γ, the zone is wide and the closed magnetic surface has very small shear. For large γ, the zone is narrow and the magnetic surface has very small rotational transform and shear. Only for intermediate γ, the zone is narrow and rotational transform and shear are both large. These values of γ could be considered to be optimum values for plasma confinement. (auth)

4310 EQUILIBRIUM AND LOCALIZED CRITERIA ON MAGNETIC SURFACES WITH CROSS SECTIONS OF ARBITRARY SHAPE. Mercier, C. (CEN, Fontenay-aux-Roses, France). pp 75-78 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A new method for expanding the equilibrium parameters is described that is valid in symmetry of revolution with cross section of arbitrary shape. This method allows one to study properties of the criteria of both the first and second kinds. (MOW)

4311 STELLARATOR FIELD PRODUCED BY TWISTED COILS. Rehker, S.; Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 117-120 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

With the increasing size of stellarator experiments, construction of the helical windings becomes more and more difficult. It is, therefore, of interest to find other methods of producing the helical fields. In the Tor-2 experiment, the helical fields are produced by planar elliptical coils. A modulation of the elliptical coils out of their plane appreciably increases the rotational transform. Since this modulation of the coils turns out to contribute the greatest part of the rotational transform, the case of circular, but twisted coils was studied in greater detail. (auth)

4312 EXPERIMENTS ON THE TO-1 TOKAMAK HAVING AN AUTOMATIC SYSTEM FOR CONTROLLING THE EQUILIBRIUM. Artemenkov, L. I.; Koslov, P. I.; Melikhov, P. I.; Svishev, V. S. (Inst. of Atomic Energy, Moscow). pp 153-156 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The present experiments (H_0 = 8 kG, I_p = 15 to 20 kA) on the TO-1 device have demonstrated that, in uncased Tokamaks having an automatic system, the plasma parameters are sufficiently high and there are possibilities for their improvements. (auth)

4313 EFFECT OF SHAPING FIELDS ON DOUBLET DISCHARGES. Ohkawa, T.; Jensen, T. H.; Chu, M. S.; Fisher, R. K.; Hsieh, C. L. (Gulf General Atomic Co., San Diego, CA). pp 161-164 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The effects of the external shaping field on Doublet II discharges were studied both experimentally and theoretically. With an appropriate shaping field, a long-lasting Doublet configuration was obtained. (auth)

4314 FIRST EXPERIMENTAL RESULTS IN FINGER-RING TOKAMAK. Bortnikov, A. V.; Baiborodov, Yu. T.; Brevnov, N. N.; Zhukovskii, V. G.; Zakharov, L. E.; Orlinskii, D. V.; Pergament, V. I.; Romanovskii, N. K.; Sokolov, N. I.; Us, A. M. (Inst. of Atomic Energy, Moscow). pp 165-168 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

It was shown earlier that it is possible to increase the maximum current in the tokamak by altering the shape of the plasma-ring cross section, namely, elongating it along the axis of symmetry. Results of studies in a finger-ring tokamak are reported. Current diagrams are shown for discharge times less than 15 msec. (MOW)

4315 AXISYMMETRIC DIVERTOR IN A TOKAMAK WITH A TEAR-DROP LIKE CROSS SECTION (DIVA). Yoshikawa, M.; Shimomura, Y.; Maeda, H.; Kitsunezaki, A.; Mori, S. (Japan Atomic Energy Research Inst., Tokai). pp 173-176 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Studies made in designing the axisymmetric divertor in a tokamak device with a tear-drop-like cross section are described. (auth)

4316 COMPUTATIONAL STUDY OF SPACE-CHARGE LIMITATIONS IN DIRECT-CONVERSION SYSTEMS. Marcus, F. B.; Watson, C. J. H. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 239-242 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Some computer studies of a focusing and decelerating electrostatic ion collector for use with mirror machines are presented that take into consideration the high space-charge levels appropriate to reactor regimes. Particle-orbit tracing is described in particular. (MOW)

4317 EFFICIENCY OF VARIOUS DIVERTORS FOR SCREENING A FUSION PLASMA. Eckhartt, D.; Haas, G.; von Hagenow, K. U. (Max-Planck-Institut fuer Plasmaphysik, Garching Ger.). pp 325-328 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The various divertors proposed in the literature differ in the spatial variation of their conductance to the divertor for plasma particles outside the separatrix. A simplified model is presented of the boundary region of a fusion reactor under the action of these divertors and the radial profiles of plasma and neutral particle density are calculated. (auth)

4318 CONSIDERATIONS ON A PULSED BELT-PINCH REACTOR WITH NORMAL CONDUCTING COILS. Herold, H.; Wilhelm, R.; Zwicker, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 333-336 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

An energy balance for two belt-pinch reactor systems is made. Additional heating with 10% efficiency is included. It is shown that systems with about 400 MW_e output should be possible at M ≈ 2.4. Comparison with pulsed tokamaks shows some advantages of the belt-pinch systems. Pulsed toroidal systems with high aspect ratio need, for normal-conducting coils, unrealistic large dimensions for reasons of ohmic losses in the coils. In the compact belt-pinch geometry this is not necessarily true. Therefore, the question for a pulsed, normal-conducting high-β reactor in belt-pinch geometry is investigated. (auth)

4319 FUSION-REACTOR CHARACTERISTICS IN DEPENDENCE ON BETA AND ASPECT RATIO. Kaufmann, M.; Koeppendoerfer, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 341-344 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The choice of suitable parameters, determined by technological requirements on one side and by plasma stability properties on the other side, allows one to show that high-beta large aspect ratio stellarators with superconductive coils can well compete with low-beta stellarators and tokamaks with respect to the reactor boiler costs. (auth)

4320 REMARKS CONCERNING EXPERIMENTAL SIMULATION OF PELLET REFUELING. Chang, C. T. (Danish Atomic Energy Commission, Risoe). pp 349-352 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The physical processes and the time scales involved in the ablation of a pellet are greatly influenced by the plasma state in the reactor. Proper experimental simulation, therefore, needs a careful study. (auth)

4321 EFFECT OF A SPECIAL MAGNETIC FIELD CONFIGURATION ON THE FORMATION OF A PLASMA FOCUS. Ivanov, V. D.; Korzhavin, V. M.; Moiseeva, M. P.; Sukhareva, N. K.; Filippova, T. I. (Inst. of Atomic Energy, Moscow). pp 355-358 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

An attempt is made to apply an external magnetic field of a specially chosen geometry for controlling the position of a plasma focus in devices of the noncylindrical z pinch. The main experimental technique used was laser-interferometer measurements with a resolution of 2 nsec. (auth)

4322 EVIDENCE FOR A BROAD AND UNIFORM NEUTRON-PRODUCING PLASMA COLUMN IN THE PLASMA FOCUS. Morgan, P. D. (Culham Lab., Abingdon, Eng.); Peacock, N. J.; Cloth, P.; Conrads, H.; Maisonnier, Ch.; Pecorella, F.; Rager, J. P.; Samuelli, M. pp 359-362 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Holographic interferometry, time-of-flight measurements on the fusion reaction neutrons, and time-resolved x-ray imagery were used to specify some of the parameters of the plasma during the late-time history of the dense pinch in the 120-kJ plasma focus at Frascati. The measured parameters are in agreement with the model of a broad and uniform plasma column, which is turbulently heated after the breakup of the pinch. (auth)

4323 KIEL EXPERIMENTS OF ELECTRICALLY EXPLODED LIQUIDS CONTAINING DEUTERIUM. Fischer, U.; Jaeger, H.; Lochte-Holtgreven, W. pp 422-423 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-703705-P1.

Capillaries filled with saturated solutions of lithium dissolved in heavy ammonia were exploded. This solution contains about 70 atomic percent deuterium and has metallic conductivity comparable to that of mercury. Discharging a capacitor bank through the capillary, the emission of neutrons was observed. (MOW)

4324 LASER-DRIVEN FUSION REACTOR. Hedstrom, J. C. (to United States Atomic Energy Commission). US Patent 3,762,992. 2 Oct 1973. Filed date 1 Mar 1972. 8p.

A laser-driven fusion reactor consisting of concentric spherical vessels in which the thermonuclear energy is derived from a deuterium–tritium (D + T) burn within a "pellet", located at the center of the vessels and initiated by a laser pulse. The resulting α-particle energy and a small fraction of the neutron energy are deposited within the pellet; this pellet energy is eventually transformed into sensible heat of lithium in a condenser outside the vessels. The remaining neutron energy is dissipated in a lithium blanket, located within the concentric vessels, where the fuel ingredient, tritium, is also produced. The heat content of the blanket and of the condenser lithium is eventually transferred to a conventional thermodynamic plant where the thermal energy is converted to electrical energy in a steam Rankine cycle. (Official Gazette)

Wave Phenomena

4325 (CEA-CONF-2384) MIXING OF ELECTROSTATIC WAVES IN A RADIALLY INHOMOGENEOUS HOT ELECTRON PLASMA. Gervais, F.; Guillemot, M.; Quemeneur, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). [nd]. 4p. (CONF-730906-10). Dep. NTIS (U.S. Sales Only) $3.00.

From 11th international conference on phenomena in ionized gases; Prague, Czechoslovakia (10 Sep 1973).

Three-wave interaction was studied earlier for an infinite electron plasma or for the propagation in a circular waveguide filled with an homogeneous plasma. To fit with experimental results, it is necessary to take into account the radial decay of the density. A hot plasma radially limited by a cylindrical waveguide of radius R and immersed in a strong magnetic field is considered here. The propagation of electron Langmuir waves is considered in particular. (MOW)

4326 NEW DISPERSION RELATION FOR A STRONGLY MAGNETIZED DEGENERATE ELECTRON PLASMA WITH ANISOTROPIC PRESSURE. Canuto, V.; Chou, C.K. (Institute for Space Studies, National Aeronautics and Space Administration, Goddard Space Flight Center, New York, New York 10025). Phys. Fluids 16: No. 8, 1273-1276 (Aug 1973).

A new dispersion relation for an unbounded degenerate electron plasma imbedded in a superstrong magnetic field is derived on the basis of the Canuto–Chiu equation of state. The properties of the various types of waves are discussed for two density regimes of astrophysical interest. Propagation parallel and perpendicular to the magnetic field are examined in detail. (auth)

4327 WAVE–WAVE COUPLING IN NONRESONANT UNSTABLE SYSTEMS. Jackson, E.A.; Raether, M. (Department of Physics and Coordinated Science Laboratory, University of Illinois, Urbana, Illinois 61801). Phys. Fluids 16: No. 8, 1378-1379 (Aug 1973).

The expansion of the dielectric function, employed in deriving the equations for wave–wave coupling, often diverges if the wave–particle interactions are nonresonant. This difficulty can be avoided by expanding about the complex eigenmodes of the linear system. This is illustrated for a cold beam–plasma system. (auth)

4328 OBSERVATION OF THE BEAM–PLASMA INTERACTION BELOW THRESHOLD. Conrad, J.R.; Diaz, C.J.; Walsh, J.E. (Department of Physics and Astronomy, Dartmouth College, Hanover, New Hampshire 03755). Phys. Fluids 16: No. 8, 1300-1306 (Aug 1973).

The wave spectrum of longitudinal electrostatic fluctuations of a beam–plasma system has been studied in the regime below the threshold for exponentially growing waves. The observed wave spectrum consists of a series of triplets, one set for each natural mode of the magnetized, cylindrical, axially bounded plasma column. The lineshape and intensity of the triplets are in good agreement with a simple theory based on the linearized dispersion relation. (auth)

4329 INTERFERENCE STRUCTURE NEAR THE RESONANCE CONE. Kuehl, H.H. (University of Southern California, Los Angeles, California 90007). Phys. Fluids 16: No. 8, 1311-1320 (Aug 1973).

The interference structure near the resonance cone of an oscillating point charge in a warm magnetized plasma is investigated theoretically, using the quasistatic approximation and neglecting ion motion. Depending on the frequency and plasma parameters, the interference structure appears inside, outside, or on both sides of the resonance cone. For frequencies less than both the plasma and cyclotron frequencies, the structure lies inside the resonance cone except for frequencies near the cyclotron frequency where the amplitude is small because of cyclotron damping. For frequencies between the upper–hybrid frequency and the larger of the cyclotron and plasma frequencies, the structure lies outside the resonance cone provided the frequency and angle are sufficiently removed from the upper-hybrid frequency and 90°, respectively. A simple expression for the angular interference spacing is derived. (auth)

4330 WAVE PACKET FORMULATION OF NONLINEAR PLASMA WAVE KINETICS. Nishikawa, K.; Fried, B.D. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Fluids 16: No. 8, 1321-1328 (Aug 1973).

A theory of nonlinear plasma wave propagation is presented which contains, as particular cases, both the nonlinear Schrödinger equation for coherent waves and the kinetic wave equation for weak plasma turbulence. Fluctuations are represented as a superposition of "micro" wave packets, with finite spread but negligible overlap in wavenumber and frequency. For the case of coherent wave propagation a nonlinear Schrödinger equation is derived, generalized over precious versions in that linear Landau damping nonlinear frequency shift, nonlinear damping, and three–dimensional effects are all included, as well as the non–local, non–Markovian interaction characteristic of this equation. In the case of weak plasma turbulence, the kinetic wave equation is generalized to include self–interaction of the micro packets, which, just as in the coherent case, results in non–local, non–Markovian terms, not heretofore considered in weak turbulence formulations. (auth)

4331 CYCLOTRON OSCILLATIONS OF PLASMA IN AN INHOMOGENEOUS MAGNETIC FIELD. Timofeev, A. V. (Inst. of Atomic Energy, Moscow). Usp. Fiz. Nauk; 110: No. 3, 329-355(Jul 1973). (In Russian).

If electromagnetic oscillations are propagated in a plasma which is in an inhomogeneous magnetic field, then at some point (the resonance point) the frequency of the oscillations can become equal to the frequency of rotation of the charged particles. In this case a number of characteristic phenomena occur whose study is the purpose of this review and which are discussed under the heading of two important problems: cyclotron heating of a plasma with an equilibrium distribution of charged particles by velocities, and the stability of a nonequilibrium plasma in magnetic traps. In the equilibrium plasma the review deals with the dynamics of the resonance cyclotron interaction in a homogeneous magnetic field, cyclotron absorption in an inhomogeneous magnetic field, modulated bundles, the adiabatic wave equation, the solution of Brambilla, and effect of thermal dispersion in electron velocities. In the nonequilibrium plasma the review deals with the resonance cyclotron interaction in a homogeneous magnetic field, in a magnetic field monotonically decreasing in space, and in a nonmonotonic magnetic field. The review also covers oscillations rising with time, stability of cyclotron oscillations in magnetic traps, boundaries reflecting oscillations, boundaries absorbing oscillations, evolution of perturbations with time, cyclotron oscillations of a plasma with hot electrons, anisotropic instability, and drift-cyclotron instability. 46 references. (SJR)

4332 NONLINEAR TRANSFORMATION OF ELECTROMAGNETIC WAVES AT THE BOUNDARY OF A MAGNETOACTIVE PLASMA. Kondratenko, A. N.; Shaptala, V. G. (Kharkov State Univ.). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 7, 1118-1120(1973). (In Russian).

Equations for the subject transformation are derived. If the impinging wave activates an ordinary wave in the plasma, the amplitude of the longitudinal wave changes insignificantly. Linear transformation of an ordinary wave to longitudinal is not possible. With a normal impingement in the electromagnetic wave, arbitrary polarization in the plasma may activate an ordinary and extraordinary wave simultaneously. However, the interaction of waves of different types leads only to activation at the second harmonic of the transverse wave and does not affect the amplitude of the longitudinal wave; therefore the coefficients of transformation in this case are equal to the sum of the coefficients of transformation for the ordinary and extraordinary components of the impinging wave. (TTT)

4333 MARGINAL INSTABILITY OF TRANSVERSE ELECTROMAGNETIC WAVES IN A WEAKLY IONIZED PLASMA. Cristea, M. (Univ. Babes Bolyai, Cluj). Stud. Univ. Babes Bolyai, Ser. Math.-Phys.; 18: No. 1, 53-59(1973). (In Rumanian).

An electron magnetoactive plasma in which the collisions between electrons and neutral particles are important is considered. The frequency of the collisions depends on the speed of the electrons. The conditions for the appearance of marginal instability for the transverse electromagnetic waves are analyzed. The critical number of waves and the real part of the wave frequency are determined. (tr-auth)

4334 MODIFICATION OF NON-LINEAR ELECTROSTATIC WAVES BY RESONANT PARTICLES. Schamel, H. (Max-Planck Institut fuer Physik und Astrophysik, Munich). (1973). vp. (In German).

From spring meeting of the German Physical Society: pulse physics, plasma physics and gas discharges, quantum optics; Berlin, Germany (9 Apr 1973).

A theoretical treatment is given of stationary electrostatic waves with resonant charged particles (e.g., in cases of plasma damping, ionospheric waves, bow shocks). A self-consistent solution of the Vlasov–Poisson system is set up. The treatment of dispersion relations is followed by a discussion of stationary waves near equilibrium, which is the interaction of slowly varying waves with the particles. (GE)

4335 NUMERICAL TREATMENT OF SHOCK WAVES IN PLASMAS WITH A COLLISIONLESS ION COMPONENT. Chodura, R.; Roethlein, B. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). (1973). vp. (In German).

From spring meeting of the German Physical Society: pulse physics, plasma physics and gas discharges, quantum optics; Berlin, Germany (9 Apr 1973).

Using a system of equations which consists of a mixture of fluid equations for electrons and particle equations for ions, a model was developed to describe the behavior of ions and the so-called viscosity heating in greater detail. The two cases of subcritical and supercritical shock waves are treated by the PIC method (calculation of electromagnetic fields at discrete mass points and interpolation/determination of particle species and velocities as continuous). (GE)

4336 SPATIAL ELECTRON CYCLOTRON DAMPING. Minami, K.; Takeda, S. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 35: No. 2, 631(Aug 1973).

Recently Olson (Phys. Fluids, 15: 160(1972)) discussed possible experimental conditions to verify spatial electron cyclotron damping of electron cyclotron waves. He also criticized the author's experiment (Phys. Fluids, 12: 1089(1969)) in which the effect of collisions between the plasma constituents on the observed wave attenuation was evaluated to detect the cyclotron damping. Here, the authors modify their interpretation to make a comparison of the observed attenuation directly with a theoretical prediction that includes effects of collisions and cyclotron damping. (auth)

4337 SOME SPECIFIC FEATURES OF SURFACE-WAVE PROPAGATION IN A NONUNIFORM PLASMA. Demchenko, V. V.; El-Siragy, N. M.; Hussein, A. M.; Zayed, K. E. (Atomic Energy Authority, Cairo). Nucl. Fusion; 13: No. 5, 665-669(Oct 1973).

It is demonstrated that the allowance for "axial" and "radial" — with respect to the direction of surface-wave propagation — inhomogeneities of plasma density, first, results in a variation of the spatial distribution of the electric field amplitude and, secondly, the frequencies of the propagating surface waves turned out to be local functions of the co-ordinates. The latter point is important in the interaction of charged-particle beams with surface waves. Indeed, the function ω_{sw} ($\vec{r}$) gives rise to a dependence of the phase velocity ($v_{ph} = \omega_{sw}/k$) on the co-ordinates. Since the most intensive energy exchange between the beam and the surface wave occurs under Cherenkov resonance ($v_{ph} = v_s$, where v_s is the beam velocity) the density inhomogeneity affects the conditions of resonance. For this reason, the growth rate of the unstable oscillations decreases. (auth)

4338 WAVE PROPAGATION IN PLASMA HAVING SMALL TEMPERATURE GRADIENT. Bondyopadhaya, R.; Paul, S. N. (Jadavpur Univ., Calcutta). Fizika (Zagreb); 5: No. 3, 139-144 (Aug 1973).

The wave propagation through a hot and nonuniform plasma is studied from the dispersion relation. It is found that the temperature gradient can affect the wave propagation and it helps the damping or instability of the longitudinal wave. (auth)

4339 LIGHT SCATTERING IN A DENSE COLD PLASMA. Platisa, M. M. (Inst. of Physics, Belgrade). Fizika (Zagreb); 5: No. 3, 131-138(Aug 1973).

Nearly all theories of light scattering from plasma, based on random-phase approximation, assume a large number of charged particles in a sphere of the Debye radius. This basic assumption was not valid for the dense cold theta-pinch plasma used in this experiment. The cooperative domain was realized even at an observation angle of $\Theta = 90°$. The ion line was spectrally resolved and the scattering spectra were found to fit the theoretical profiles, within the limits of experimental error. It is shown that scattering theories can be applied even in the case of 0.7 particles per Debye sphere in accordance with Theimer's extended nonlinear correction theory. (auth)

4340 SPATIAL EVOLUTION OF ELECTRON ENERGY DISTRIBUTION UNDER INFLUENCE OF A LARGE-AMPLITUDE PLASMA WAVE. Barbian, E. P. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). pp 465-468 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Trapping of electrons in a large-amplitude wave trough is experimentally investigated. The spatial evolution of the trapped-particle hump within the electron energy distribution is shown to be correlated with the oscillation of the wave amplitude. Conversely, the result of detrapping by a second wave is likewise demonstrated. (auth)

4341 COMPUTATION OF ION-ACOUSTIC WAVE EXCITATION AND ITS ANOMALOUS EFFECTS FOR DOUBLE-SIDED LASER–PLASMA INTERACTION. Wilhelmsson, H.; Oestberg, K. (Inst. of Electromagnetic Field Theory, Goteborg). pp 469-472 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Computer results based on a self-consistent nonlinear analysis are given for the (one-dimensional) problem of laser interaction with a plasma layer. The effects of ion-acoustic wave excitation are studied, assuming that the plasma is exposed to incident radiation from two oppositely directed laser beams. (auth)

4342 INVESTIGATION OF NONSTATIONARY SELF-FOCUSING OF ELECTROMAGNETIC WAVES IN PLASMA. Isaev, V. A.; Kruglov, V. N.; Litvak, A. G.; Poluakhtov, B. K. (Radiophysical Research Inst., Gorky, USSR). pp 473-476 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Experimental results of the thermal self-focus of a beam of millimeter electromagnetic waves in plasma are given. The main attention is concentrated upon the nonstationary stage of the effect. (auth)

4343 EFFECT OF MAGNETIC FIELD ON THE INTERACTION BETWEEN A RELATIVISTIC ELECTRON BEAM AND PLASMA. Breizman, B. N. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 491-494 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The role of helicons in the process of relaxation of the relativistic electron beam is investigated. The conditions are found, under which helicons rather than Langmuir oscillations are responsible for the relaxation. The relaxation length is estimated for the problem of stationary injection of the beam into plasma. (auth)

4344 FUNDAMENTAL AND SATELLITE WAVE GENERATION IN MODULATED BEAM–PLASMA SYSTEMS. Sunka, P. (Inst. of Plasma Physics, Prague). pp 517-520 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The nonlinear interaction of an initially cold weakly modulated electron beam (beam current $I_b \leq 6$mA, voltage $U_b = 4$kV, diameter 5 mm) with magnetized ($B_0 = 360$G) argon plasma (initial electron temperature $T_e \approx 5$eV, diameter 8 mm) produced by an external source was studied. The beam was modulated at 1.5 of the electron cyclotron frequency ($f_M = 1535$ MHz). The plasma density η_b ensuring the largest spatial growth of the beam-excited wave near the injector was then adjusted. Under the experimental conditions, only the Cherenkov type of interaction ($\omega \approx k_{||} V_b$) of the beam with the upper branch of electron plasma oscillations ($\max(\omega_p^2, \omega_B^2) < \omega^2 < (\omega_p^2 + \omega_B^2)$) was observed. All measurements were performed slowly i.e., point by point during many injection pulses. (auth)

4345 MECHANISM OF STOCHASTIC OSCILLATION EXCITATION AT DEVELOPMENT OF BEAM INSTABILITY IN PLASMA. Lavrovskii, V. A.; Kharchenko, I. F.; Shustin, E. G. (Inst. of Radio Engineering and Electronics, Moscow). pp 529-532 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

A relation between a structure of high-frequency oscillations excited at beam–plasma instability development and a form of instantaneous distribution function of beam electrons on the interaction region terminal is analyzed. Statistical relations of oscillation-phase behavior are developed. Stochastization of oscillations is shown to occur due to trapped-particle instability. (auth)

4346 TRANSFORMATION OF ELECTRON BEAM VELOCITIES DISTRIBUTION FUNCTION AT INTERACTION OF MODULATED ELECTRON BEAM WITH PLASMA. Rogashkova, A. I.; Tseitlin, M. B.; Lavrovskii, V. A.; Kharchenko, I. F. (Inst. of Radio Engineering and Electronics, Moscow). pp 533-536 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The interaction of the velocity-modulated electron beam with longitudinal waves in plasma in the nonlinear regime was investigated. The phase trajectories of an electron beam, the electron velocity distribution function, the space-charge field amplitudes, and the electron velocities in the phase at different stages of interaction were determined. (auth)

4347 ABSORPTION OF INTENSE ELECTROMAGNETIC WAVES BY DENSE COLLISIONLESS PLASMA. Brodskii, Yu. Ya.; Golubev, S. V.; Gol'tsman, V. L.; Litvak, A. G. (Radiophysical Research Inst., Gorky, USSR). pp 549-552 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

It is experimentally discovered that the anomalous absorption of microwave energy leads to the bleaching of "transcritical" plasma. Threshold field values obtained and the characteristic time of dissipation are in good agreement with the assumption on the hydrodynamic instability occurrence. (auth)

4348 RESONANCE EXCITATION OF LARGE-AMPLITUDE OSCILLATIONS IN A NONUNIFORM PLASMA NEAR ION CYCLOTRON RESONANCE. Grigor'eva, L. I.; Smerdov, B. I.; Sapogov, S. A.; Chechkin, V. V. (Physical-Technical Inst., Kharkov). pp 557-560 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Resonance excitation of large-amplitude oscillations near ion gyrofrequency ω_{Hi} was studied in a radially nonuniform plasma cylinder. A resonance layer was found in which a sharp increase of the amplitude of the alternating field takes place. (auth)

4349 PROPAGATION OF SWITCH-ON SHOCK IN A MAGNETIZED COLLISIONLESS PLASMA. El-Khalafawy, T.; El-Nicklawy, M.; El-Gwaily, M.; Beshara, A.; Demnchenko, V.; Rudnev, N. I. (Atomic Energy Authority, Cairo). pp 569-572 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The results of the experimental investigations of the parameters and structure of a shock wave propagating along a static magnetic field are discussed. It is also shown that the wave observed represents a "switch-on" shock, the structure of which is determined by the mechanism of the energy "collisionless" dissipation. (auth)

4350 EXPERIMENTS ON MAGNETO-ACOUSTIC EIGEN OSCILLATIONS IN A PLASMA CONFINED IN A PURELY POLOIDAL MAGNETIC FIELD. Bures, M.; Tennfors, E.; Thorstensen, B. (Royal Inst. of Tech., Stockholm). pp 575-578 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Oscillations are excited at the lowest magneto-acoustic resonance of a plasma confined in an internal-ring device. The eigenfrequency and the velocity of propagation through the plasma are observed to vary with heating power and velocity of rotation. The dependence of ion mass agrees with the theory for Alfvén waves. (auth)

4351 PROPAGATION OF TORSIONAL ALFVEN WAVES IN INHOMOGENEOUS AXISYMMETRIC MAGNETIC FIELDS. Mueller, G.; Raeuchle, E.; Schueller, P. G. (Univ., Stuttgart). pp 591-594 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The propagation of torsional Alfvén waves in axially symmetric, inhomogeneous magnetic fields is investigated. Field inhomogeneities cause partial reflection and trapping of the waves. (auth)

4352 CANONICAL METHOD FOR CALCULATION OF ELECTROSTATIC PLASMA WAVES AND ENERGY-MOMENTUM CONSERVATION LAWS. Lacina, J. (Inst. of Plasma Physics, Prague). pp 639-642 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

Using a method of canonical variables, a set of equations for the nonlinear evolution of wave amplitudes and of macroscopic quantities is derived for a collisionless plasma; this set of equations is suitable for computer calculations of plasma waves and instabilities. It is shown that the equation for the complex wave amplitudes is equivalent to the energy–momentum conservation laws. (auth)

4353 EXCITATION OF ELECTROMAGNETIC WAVES IN PLASMA BY FUSION PRODUCTS. Kaladze, T. D.; Lominadze, D. G.; Stepanov, K. N. (Tbilisi State Univ., USSR). pp 646-649 of Sixth European Conference on Controlled Fusion and Plasma Physics. Vol. I. Dubna, USSR; Joint Inst. for Nuclear Research (1973).

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973). See CONF-730705-P1.

The excitation of fast magnetosonic, Alfvén and nonpotential ion cyclotron waves by high energetic ions is studied, the ions being produced in fusion reactions. Growth rates and thresholds of excitation of these instabilities were obtained. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 2737, and 2891–2893.

4354 (CLOR–93/D) PROCESSING OF THE RESULTS OF INDIVIDUAL RADIATION DOSE MEASUREMENTS BY GIER COMPUTER. Smoniewski, J.; Sawicka, W.; Mamont-Ciesla, K. (Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland)). 1973. 25p. (In Polish). Dep. NTIS (U. S. Sales Only) $3.25.

The application of a computer to processing of individual radiation dose measurements results is the necessity of changing the present control system. Changes in the documentation leading to amplications in data preparations are proposed as well as the flow chart and basic tasks of computer programs which will realize time consuming and laborious works connected with data processing. Processing of modified monitoring system was tested partly by GIER computer, using the language of GIER–ALGOL IV. (auth)

4355 (FMI-1000-422) THEORY OF OPTIMUM UTILIZATION OF ALL DETECTED RADIATION. Beck, R. N.; Zimmer, L. T.; Charleston, D. B.; Shipley, W. W.; Brunsden, B. S. (Chicago Univ., Ill. Dept. of Radiology; Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1973. 19p. (CONF-730321-3). Dep. NTIS $3.00.

From semiconductor detectors in medicine meeting; San Francisco, California, USA (8 Mar 1973).

Some conclusions based on work toward the goal of making the fullest use of all of the radiation detected during nuclear medicine imaging procedures in order to minimize the radiation dose to the patient while maximizing the diagnostic image quality are summarized. A series of studies were done to determine the effects of scattered radiation on the sensitivity and spatial resolution of imaging systems. The following are discussed: the theory of optimum-weighted multichannel imaging, detection of arbitrary object structures, and detection of sinusoidal structures. (MHR)

4356 (IEA-260) THERMAL DIFFUSE SCATTERING OF X-RAYS. Borgonovi, G. M.; Fulfaro, R.; Imakuma, K.; Rodrigues, C.; Vinhas, L. A. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Feb 1972. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

The activities in the field of thermal diffuse scattering of x-rays performed during the period from Feb. 1971 to Jan. 1972 are described. The activities were both experimental and computational. The existent apparatus was modified in order to measure the diffuse scattering in a copper crystal. Therefore x-ray monochromatization and monitoring systems were constructed. In the computational field several codes were prepared and tested; the main code is a program for the exact calculation of the second order diffuse scattering. (auth)

4357 (LA-5326-MS) UNIFORM DOSE DISTRIBUTION WITH MOVING NEGATIVE PION BEAMS. Rodgers, E. (Los Alamos Scientific Lab., N. Mex.). Jul 1973. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

Dense ionization in the stopping region as negative pions come to rest in matter makes them attractive for treatment of cancer. Pions of the same energy have essentially the same range in matter which means that a monoenergetic beam will produce a Bragg peak region of maximum ionization as they come to rest. In cancer therapy, the entire treatment volume should be exposed, if possible, to the Bragg peak. A distribution of energy and adjustment of lateral dimensions could theoretically adjust the Bragg peak to fit into most any treatment volume but this might be difficult in practice to accomplish. As an alternative, the beam can be tuned to produce a peak with known properties, and this peak can be moved in a controlled manner so as to scan the treatment volume. For a vertical beam, this method usually will require vertical oscillations of the beam as well as horizontal motion to cover the entire volume. Both of these motions can result in undesirable dose distributions. It is shown how to avoid or minimize the unwanted effects and it is also shown how velocity distributions can be determined for uniform effective dose throughout a treatment volume. (auth)

4358 (ORNL-TM-4393) BRHGAM: A MEDICAL X-RAY DOSE ESTIMATION PROGRAM. Warner, G. G. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 28p. Dep. NTIS $3.50.

Herein described is a Monte Carlo computer program which is utilized to calculate estimates of absorbed dose in several body organs of an adult human phantom. The source of radiation is a simulated external beam of x-rays. (auth)

4359 (TID-26455) PION CHANNELING IN CRYSTALS. Gemmell, D. S. (Argonne National Lab., Ill.). 1973. 53p. Dep. NTIS $4.75.

A brief review of some of the channeling work already done, a discussion of the significance of extending the work to meson channeling, and a short description of the channeling experiments to be begun at LAMPF around the end of 1973 or early 1974 are given. (JFP)

4360 DISTRIBUTION AND FRACTION OF BREMSSTRAHLUNG ENERGY ABSORBED IN TISSUE-EQUIVALENT FORMS. Vorob'ev, V. A.; Gol'dberg, E. D.; Kolbin, H. M.; Sokolov, G. P.; Pickugin, V. G. pp 52-55 of Voprosy Radiobiologii i Biologicheskogo Deistviya Tsitostaticheskikh Preparatov. Gol'dberg, E. D. (ed.). Tomsk, USSR; Izdatel'stvo Tomskogo Universiteta (1969). (In Russian).

Values for absorption of subject radiation in phantoms of different thicknesses are tabulated and curves are shown for space distribution of the absorbed energy according to depth. The formula for calculating the energy is given. (TTT)

4361 MEASUREMENT OF NUCLEAR RADIATIONS. Marin, B. Elec.-Electron. Mod.; No. 274, 37-44(Jun 1973). (In French).

The principal constituents of the nucleus of an atom are recalled. Nuclear radiations, natural and artificial radioactivities and, the characteristic physical data are then discussed. The basic units used in radioprotection are also presented. (auth)

4362 SCATTERING OF ELECTRONS IN BISMUTH. Cheremisin, S. M. (Inst. of Physical Problems, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1564-1570(Oct 1973). (In Russian).

The state of the problem of the mechanism of electron scattering in bismuth is analyzed. The probability for scattering of electrons by phonons is calculated by taking into account anisotropy of the deformation potential and phonon spectrum. Comparison of the calculations with the experimental results shows that the data on the temperature dependence of the electric conductivity of bismuth can be satisfactorily described by a model of intervalley scattering of electrons by phonons; on the other hand the results of investigation of relaxation by the cyclotron resonance technique cannot be completely explained by the model or by taking into account electron–electron scattering and intervalley scattering by phonons. Some possibilities of further investigations are discussed. (auth)

4363 REVISED PARAMETERS FOR USE IN LOEVINGER'S BETA POINT-SOURCE DOSE-DISTRIBUTION FUNCTION. Murthy, M. S. S.; Venkataraman, G.; Datta, S. (Bhabha Atomic Research Centre, Trombay). J. Nucl. Med.; 14: No. 11, 846-849(Nov 1973).

Even though extensive data in tabular form on beta point-source dose-distribution in water and air have been made available by Cross and Berger, Loevinger's beta point-source dose-distribution function is the only equation available in an analytical form that can be used to calculate the dose from extended sources. However, constants employed in this equation were based on scanty experimental data which were available in the 1950s. It was seen that Loevinger's original parameters give fairly accurate dose-distribution values for beta emitters of maximum energy less than 1 MeV, while for high-energy emitters the dose values using the original constants were less by about 20% compared with Cross's values. Hence, the parameters in Loevinger's equation have been reevaluated for high-energy beta emitters. (auth)

Radiation Protection Standards

Refer also to abstract 2881.

4364 RATIFICATION OF THE ILO RADIATION PROTECTION AGREEMENT. Jeiter, W.; Thomas, H. P. (Bundesministerium fuer Arbeit und Sozialordnung, Bonn). Atomwirt., Atomtech.; 18: No. 8-9, 398-399(1973). (In German).

The Agreement No. 115 of the ILO which has recently been ratified by the FRG controls the protection of employees against ionizing radiation. The regulations of this agreement are fulfilled for almost all types of application by the German radiation protection regulations. The still existing gap concerning accelerator facilities shall be closed in the near future by an amendment of the First Radiation Protection Ordinance. (GE)

Radiation Source Calibration and Standardization

Refer also to abstracts 2702, 2723, 2724, 2745, and 3871.

4365 PROBLEMS IN MICROWEIGHING. Le Gallic, Y. (CEN, Saclay, France). Nucl. Instrum. Methods; 112: No. 1-2, 333-341(1973).

In order to obtain increasingly accurate activity measurements it is necessary to analyse all the parameters likely to affect this accuracy. Microweighing is, at present, a substantial source of error, since the precision of microbalances is sometimes well below the specifications published by the constructors. The nonlinearity of the optical scale, the error on its calibration and the variation of this calibration with the sensitivity adjustment lead to errors of 5 to 10 μg. The various combinations of weights lead to errors very often greater than 20 μg and sometimes reaching 100 to 200 μg. These different factors result in appreciable errors in the determination of the mass of a microdrop. The best solution is obviously to convert these errors to corrections, but for this a set of high-quality reference weights and the means to conserve them would be necessary. Various methods are proposed to minimise the errors in weighings with type M-5 mechanical microbalances. A prospective study on the results to be expected from electrobalances is also undertaken. (auth)

4366 PRESENT STATUS IN QUANTITATIVE SOURCE PREPARATION. Merritt, J. S. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Instrum. Methods; 112: No. 1-2, 325-332(1973).

At present the essence of quantitative source preparation in the metrology of radionuclides is the accurate sampling of aqueous solutions at the micro to meso scale of operations. Volumetric methods are discussed only briefly because higher accuracy and precision are obtainable gravimetrically. The pycnometer method has evolved as the preferred gravimetric method. Procedures using it are outlined for the quantitative preparation of dilutions of a primary solution standard and for the delivery of solution samples to source mounts or containers. Sources of error in the various steps of these procedures are examined and their importance is discussed. A few recommendations for good analytical practice are included. In this context the choice among commercially available balances is reviewed. Because the substitution-type balance has been selected by most laboratories in this field, tests for the evaluation of its performance are outlined and some results for the Mettler M-5 balance are given. Methods of source preparation are also reviewed and two promising new approaches are cited. It is concluded that techniques developed in the fields of mass metrology and analytical chemistry are important to accurate radioactivity determinations. (54 references) (auth)

4367 USE OF ^{56}Mn TO CHECK MEASURING EQUIPMENT. Lagoutine, F.; Legrand, J. (CEN de Saclay, Gif-sur Yvette, France). Nucl. Instrum. Methods; 112: No. 1-2, 323(1973).

Careful measurements of the ^{56}Mn half-life by three different methods led to $T_{½} = (2.5785 \pm 0.0006)$ h, a value which can usefully be applied for checks of measuring devices. (auth)

4368 ALPHA-PARTICLE ENERGY STANDARDS. Rytz, A. (Bureau International des Poids et Mesures, Sevres, France). Nucl. Instrum. Methods; 112: No. 1-2, 261-264(1973).

Since absolute energy measurements are not possible with doubly focussing magnetic spectrometers, most α-spectroscopists relied largely on a few standard energies determined by Rosenblum and Dupouy and by Briggs. Although more absolute results became available later, some major inconsistencies remained and caused difficulties in interpreting α-ray spectra. Since 1969, 22 α-emitters and 35 lines have been measured in the absolute magnetic spectrograph of the BIPM. The results are compared with the values found in the most commonly used compilations. They are useful in calibrating various types of spectrometers and in atomic mass calculations. A new compilation of α-energy data is now in preparation. (auth)

4369 RADIOACTIVE X-RAY STANDARDS. Fink, R. W. (Georgia Inst. of Tech., Atlanta). Nucl. Instrum. Methods; 112: No. 1-2, 243(1973).

The increased use of low-energy semiconductor spectrometers in problems requiring accurate knowledge of the absolute efficiency and photon energy have created an urgent need for reliable calibration sources in the low energy region. A number of sources can now be produced with heavy ion accelerators and isotope separators, but techniques for calibrating these sources in terms of their absolute emission rates are required. A new calibration technique using a multiwire proportional counter is outlined, which enables one to standardize a number of sources against one or two primary standards. (auth)

4370 USE OF SOURCES MADE ON ELECTROSPRAYED PADS OF ION EXCHANGE RESINS FOR EFFICIENCY TRACER MEASUREMENTS. Lowenthal, G. C.; Page, V.; Wyllie, H. A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nucl. Instrum. Methods; 112: No. 1-2, 197-200 (1973).

Sources made on electrosprayed pads of ion exchange resins can be very effectively used for efficiency tracer measurements of radionuclides which emit mainly low energy decay products. Efficiency functions were obtained with ^{54}Mn serving as tracer for ^{51}Cr and ^{55}Fe and the radioactivity concentration in a sample of a solution of ^{63}Ni prepared at the U. S. National Bureau of Standards was determined with ^{60}Co as tracer. The result is compared with previously published values with particular reference to sources of systematic uncertainties. (auth)

4371 SUM-PEAK COUNTING WITH TWO CRYSTALS. Hutchinson, J. M. R.; Mann, W. B.; Mullen, P. A. (National Bureau of Standards, Washington, DC). Nucl. Instrum. Methods; 112: No. 1-2, 187-196(1973).

Very great improvements in accuracy of measurements of radioactivity by the sum-peak technique of coincidence counting have been achieved by the utilization of two NaI(Tl) crystals. Taking advantage of the coincidence and anticoincidence possibilities in this arrangement, equations and techniques have been developed, so that accuracies obtainable by the sum-peak technique are improved by an order of magnitude, and become comparable to those obtainable by means of conventional β-γ and γ-γ coincidence counting. Good statistical accuracy can be obtained quickly, and many small but often laboriously determined corrections, which appear in β-γ and γ-γ coincidence counting, are unimportant in this new method, which has been applied to the standardization of ^{60}Co, ^{94}Nb, ^{88}Y, ^{22}Na, ^{26}Al and ^{207}Bi. (auth)

4372 SOME SPECIAL PROBLEMS IN COINCIDENCE MEASUREMENT. Perolat, J. P. (Laboratoire de Metrologie des Rayonnements Ionisants, Saclay, France). Nucl. Instrum. Methods; 112: No. 1-2, 179-185(1973).

Two kinds of "4π β-γ" coincidence methods can be used for the calibration of β-γ and EC-γ emitting radionuclides with complex disintegration schemes: (1) an extrapolation method which gives the activity without involving the parameters of the disintegration schemes, and (2) a method using the disintegration scheme parameters. Some examples of the second method are examined: ^{65}Zn, ^{99}Mo, ^{59}Fe. Then some cases of other coincidence techniques are considered; viz., X_K-γ, X_K-X_K, X_L-X_L and K–L coincidence methods applied respectively to ^{54}Mn, ^{125}I, ^{197}Hg and ^{131}Cs. (auth)

4373 PROBLEMS AND POSSIBILITIES OF BREMSSTRAHLUNG COUNTING. Spernol, A.; De Roost, E.; Mutterer, M. (EURATOM, Geel, Belgium). Nucl. Instrum. Methods; 112: No. 1-2, 169-187(1973).

Better understanding of bremsstrahlung and modern experimental techniques, especially the use of GeLi detectors for the determination of weak γ-impurities, may today allow to make wider use of bremsstrahlung counting in the metrology of radionuclides. Therefore, present theoretical and experimental knowledge of the different types of bremsstrahlung is first briefly reviewed. Then some known or possible applications of bremsstrahlung counting and corrections for bremsstrahlung in other methods are discussed. Finally the $4\pi\beta$-bremsstrahlung coincidence method for the measurement of pure β-emitters or nuclides decaying by pure electron capture is described and some new experimental results are presented. Conclusions concerning fundamental principles of coincidence counting can be drawn from these results. (86 references) (auth)

4374 TRACER METHOD FOR PURE BETA EMITTER MEASUREMENT. Steyn, J. (NPRL, Pretoria). Nucl. Instrum. Methods; 112: No. 1-2, 157-163(1973).

A brief historic review of the tracer method for pure β-emitter measurement is given. Some of the latest results in the literature are discussed to assess the present status of the method. It would appear from the results that efficiency tracing with the use of solid sources in 4π-proportional counters is now well established, provided sufficient care is taken with the extrapolation to unit counting efficiency, which is a main feature of the method. Use of the internal liquid scintillation counter as 4π-detector in the method of efficiency tracing is also discussed. In this case the method is perhaps not yet so widely accepted. (auth)

4375 SOURCES OF SYSTEMATIC ERRORS IN EFFICIENCY TRACER MEASUREMENTS. Lowenthal, G. C. (Australian

Atomic Energy Commission Research Establishment, Lucas Heights). Nucl. Instrum. Methods; 112: No. 1-2, 165-168(1973).

The results of extrapolations of measured efficiency tracer functions of pure β emitters are shown to depend on the range of counting efficiencies over which the measurements are made. This leads to uncertainties, which are most effectively reduced by starting the measurements with sources of the highest attainable counting efficiencies and subsequently reducing these efficiencies no further than is necessary to establish the efficiency tracer function with adequate accuracy. (auth)

4376 ACCURACY OF COINCIDENCE MEASUREMENTS. Grigorescu, L. (Radionuclide Metrology Lab., Bucharest). Nucl. Instrum. Methods; 112: No. 1-2, 151-155(1973).

By referring to published literature, corrections and measurement conditions determining the accuracy of the coincidence method are discussed. The decay scheme, dead time and resolving time corrections are considered. Some suggestions are made for high accuracy measurements. (auth)

4377 EFFICIENCY EXTRAPOLATION METHOD IN COINCIDENCE COUNTING. Baerg, A. P. (National Research Council, Ottawa). Nucl. Instrum. Methods; 112: No. 1-2, 143-150(1973).

A variety of nuclear species can now be measured by 4π $\beta\gamma$-coincidence methods making use of extrapolation procedures, but without requiring detailed knowledge of decay scheme parameters. By varying the β-detector efficiency an experimental function is obtained giving the β-channel counting rate in terms of the coincidence-to-γ-channel counting ratio, N_c/N_γ. This function is taken to give the source disintegration rate when N_c/N_γ has unit value. The techniques used in practice are reviewed and the theory examined in some detail to show how valid measures can be achieved experimentally. Since least squares data fitting plays an important role in the extrapolation procedure, methods are outlined which currently appear to be essentially free of major ambiguities. (auth)

4378 SPECIAL PROBLEMS INVOLVED IN LIQUID SCINTILLATION COUNTING: STANDARDIZATION OF ^{87}Y and ^{67}Ga. Steyn, J. (NPRL, Pretoria). Nucl. Instrum. Methods; 112: No. 1-2, 137-141(1973).

The problems caused by non-coincident γ-radiation and internal conversion electrons in the standardization of the electron-capture nuclides ^{87}Y and ^{67}Ga are discussed. Determination of the disintegration rate by $4\pi X$-γ coincidence counting with use of the liquid scintillation counter as 4π-detector is described. Impulses caused by internal-conversion electrons and γ-rays in this counter are rejected by suitable pulse-height selection. The accuracy of the method depends on a knowledge of the intensities of the γ-rays and the efficiency of the liquid scintillation counter for these rays. (auth)

4379 NEEDS FOR RADIOACTIVITY STANDARDS AND MEASUREMENTS IN DIFFERENT FIELDS. Cavallo, L. M.; Coursey, B. M.; Garfinkel, S. B.; Hutchinson, J. M. R.; Mann, W. B. (National Bureau of Standards, Washington, DC). Nucl. Instrum. Methods; 112: No. 1-2, 5-18(1973).

With the enormous and worldwide increase in the applications of radioactive materials in so many scientific and technological fields, a corresponding need has arisen for increased skill and improved facilities for the assay of such materials. In the U. S. A., the use of radioisotopes, including radiopharmaceuticals is about \$80 million annually. The measurements skills and facilities must of necessity tend to lag behind such a rapid growth, and increasingly from many quarters we at the National Bureau of Standards are being requested for help in establishing a consistent measurements system in radioactivity traceable both to us and through us to the international measurements system. The measures being taken in order to achieve such traceability in a consistent measurements system in different fields of radioactivity are discussed, with special emphasis on environmental and radiopharmaceutical measurements. (auth)

4380 STANDARD NEUTRON CROSS SECTIONS FOR THE MEASUREMENT OF BEAM DENSITY. Vasil'ev, R. D. (All-Union Scientific Research Inst. of Physical-Technical and Radiotechnical Measurements, Moscow); Tolstikov, V. A.; Shevchenko, V. F. pp 158-163 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

This report is a survey concerning standard neutron cross sections for the reactions ^{10}B(n,α)^{7}Li^{7}Li*, ^{6}Li(n,t)^{4}He, ^{3}He(n,p)T, ^{197}Au(n,γ)^{198}Au, H(n,n)H, and ^{235}U(n,f) that are used for neutron flux density measurement in the range from thermal energy up to ~ 15 MeV. Modern trends in this field are analyzed, and some of the standard (recommended) values and energy dependencies of the cross sections are listed. (auth)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 3454, 3481, 3607, 4434, and 4704.

4381 (JINR-P2-7424) RELATIVISTIC DENSITY MATRIX IN PHASE SPACE. Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 14p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

An equation is obtained for relativistic plasma oscillations taking into account the particle spin. (auth)

4382 (ORO-3992-139) ALGEBRAIC STUDY OF A CLASS OF RELATIVISTIC WAVE EQUATIONS. Hurley, W. J.; Sudarshan, E. C. G. (Texas Univ., Austin (USA). Center for Particle Theory). Aug 1973. Contract AT(40-1)-3992. 76p. (CPT-188). Dep. NTIS $6.00.

First order relativistic wave equations are considered whose irreducible matrix coefficients satisfy the simplest (except for the Dirac algebra) unique mass condition, $(\beta \cdot p)^3 = p^2(\beta \cdot p)$, which is also sufficient to guarantee causality in a minimally coupled external electromagnetic field. All of the associated representations of SL(2,¢) are classified and studied up to and including those which are the direct sum of four irreducible components, (n,m), with either n or m less than two. A large number of families of representations are found which permit the algebraic condition to be satisfied. These are tabulated according to whether a Hermitian choice for β^0 is possible and their spin content is given. If a unique spin is described then the only possible representations are $(n,o) \oplus (n - \frac{1}{2}, \frac{1}{2})$, $(n,o) \oplus (n + \frac{1}{2}, \frac{1}{2})$, $(n + \frac{1}{2}, \frac{1}{2}) \oplus (n,o) \oplus (n - \frac{1}{2}, \frac{1}{2})$, and $(1,0) \oplus (\frac{1}{2}, \frac{1}{2}) \oplus (0.1)$, and their conjugates. If, in addition, the representation is assumed to be self-conjugate then only the Dirac and Petiau–Duffin-Kemmer equations survive. (auth)

4383 HEISENBERG UNCERTAINTY RELATIONS IN THE NON-HAMILTONIAN QUANTUM STATISTICAL MECHANICS. Ingarden, R. S. (Univ., Torun, Poland). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 21: No. 6, 579-580(1973).

By a simple example of quantum irreversible motion (according to A. Kossakowski's theory) solved rigorously in the Heisenberg picture it was shown that for time $t \to \infty$ position q(t) and momentum p(t) go exponentially to zero. This, however, does not imply that the Heisenberg uncertainty relation for q and p vanish at infinite time since this relation is determined by $[q,p](t) = i$, and not by $[q(t),p(t)] = ie^{-2\sigma t}(\sigma > 0,\ t \geq 0,\ \hbar = 1)$. (auth)

4384 WAVE STATISTICS. Its Principles and Applications. Kar, K. C. Calcutta; Institute of Theoretical Physics (1966). 167p.

The topics cover wave and quantum statistics, relativistic extension of the Schroedinger equation and eigen-energy, wave function for particles without and with spin, relativistic wave statistics, intensity of series spectra and doublets, linear Hamiltonian in an electromagnetic field, wave statistical interpretation of classical mechanics, the wave statistical average, the Zeeman and Stark effects, perturbation theory with time dependent wave function, an assembly of linear oscillators, radiation in equilibrium with matter, quantization of the radiation field, the photoelectric and Compton effects, the Klein-Nishina formula, bremsstrahlung, pair production, the process of annihilation, the nature of the short range potential, and linearization of the relativistic Hamiltonian. (JFP)

4385 EXPECTATION VALUES OF UNBOUNDED OBSERVABLES. Kraus, K. (Univ., Wuerzburg, Ger.); Schroeter, J. Int. J. Theor. Phys.; 7: No. 6, 431-442(1973).

For an unbounded quantum mechanical observable A, the expectation value $\langle A \rangle_f$ and the mean square deviation $\Delta_f A$ cannot be defined for all (pure) states f by $\langle A \rangle_f = (f,Af)$ and $(\Delta_f A)^2 = (f,A^2 f) - (f,Af)^2$, respectively. More general definitions are given, which are also valid for state mixtures (density matrices). A general uncertainty relation for unbounded observables is derived. (auth)

4386 EQUATIONS OF MOTION IN A CYLINDRICAL FIELD. Klotz, A. H.; Russell, G. K. (Univ. of Sydney). Acta Phys. Pol.; B4: No. 5, 589-593(1973).

The equations of motion of a test particle are derived from the field equations of Einstein's unified field theory in the case when there is a cylindrically symmetric source. An exact form of the equations of motion, corresponding to a particular solution of the field equations, is obtained. (auth)

4387 STRUCTURE OF NONSYMMETRIC UNIFIED FIELD THEORIES. Klotz, A. H.; Russell, G. K. (Univ. of Sydney). Acta Phys. Pol.; B4: No. 5, 579-588(1973).

The structure of a unified field theory is investigated in which the non symmetric "Ricci" tensor is expressed in terms of the most general variables with respect to which it is automatically transposition invariant in the sense of Einstein and Kaufman. It is shown that all such theories reduce to unified field theory proposed by the latter authors (E-K). Moreover, it is shown that this theory itself is fully equivalent to the theory of Einstein and Straus. Thus, unless one is prepared to complicate the Lagrangian unduly and arbitrarily, the latter appears as the only non symmetric, four dimensional extension of general relativity. Newly discovered symmetries of the theory give rise to a conservation law enabling an identification of the current vector density to be made. (auth)

4388 WAVE MECHANICS: THE FIRST FIFTY YEARS. Price, W. C.; Chissick, S. S.; Ravensdale, T. (eds.). New York; John Wiley and Sons, Inc. (1973). 445p. $37.50.

The topics discussed are the beginnings of chemical physics and wave mechanics, the development of quantum mechanics during 1924 to 1926, central fields in two vis-a-vis three dimensions, quantum theory of valence, the localization of electrons and the chemical bond, wave mechanical treatment of hydrogen bonded systems, hybrid bond orbitals, wave mechanics for the electronic structure of molecules through configuration interaction, spin and Pauli principle, time-dependent Hartree–Fock theory for atomic properties, wave mechanics effects on inorganic chemistry, and ligand fields, also group theoretic view of weakly interacting sites, role of symmetry and spin restrictions in reactive and nonreactive collisions and molecular decompositions, the role of semi-empirical SCF MO methods, the influence of wave mechanics on organic chemistry, quantum biochemistry, wave mechanics for natural optical activity in organic molecules, photoelectron spectroscopy and the electronic structure of matter, electronic structures of complex molecules and solids determination, density matrix methods in x-ray scattering and momentum space calculations, and an approach to quantum theory are covered. (JFP)

4389 OPTIMAL SEPARATION OF CENTER-OF-MASS MOTION. Vincent, C.M. (Physics Department, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Phys. Rev. C 8: No. 3, 929-937 (Sept 1973).

It is shown that a given approximate eigenfunction F of a many-body Hamiltonian can be improved by exploiting the separation of the exact eigenfunction in internal and c.m. coordinates. The method given leads reliably to a lower energy for the ground state, without requiring the solution of an additional dynamical problem. The best internal wave function (BIWF) is taken to be the internal factor of the separable wave function that has the largest possible overlap with F. The existence, uniqueness, and construction of the BIWF are derived. A canonical expansion $F = \Sigma a_i \Psi_i \psi_i$ is described, in which Ψ_i are orthogonal functions of the c.m. coordinates, and ψ_i are orthogonal functions of the internal coordinates. The canonical expansion is shown to converge faster than any other. It is applied to the discussion of the "projection" or "generator-coordinate" treatment of c.m. motion using arbitrary c.m. wave functions. It is shown that the Gartenhaus–Schwartz prescription is not equivalent to the use of any internal wave function, and gives systematically worse results for off-diagonal matrix elements than for expectation values. (auth)

4390 RADIATING AND NONRADIATING CLASSICAL CURRENT DISTRIBUTIONS AND THE FIELDS THEY GENERATE. Devaney, A.J.; Wolf, E. (Department of Physics and Astronomy, University of Rochester, Rochester, New York, 14627). Phys. Rev. D 8: No. 4, 1044-1047 (15 Aug 1973).

Several general theorems are established relating to well-behaved, localized, monochromatic current distributions and the fields that they generate. In particular, a necessary and sufficient condition for such a current distribution to be nonradiating is established and a general expression for all nonradiating current distributions of this class is obtained. (auth)

4391 LEVEL-DEPENDENT NEW TAMM–DANCOFF METHOD. Uzes, C.A.; Henkel, J.H. (Department of Physics and Astronomy, University of Georgia, Athens, Georgia 30602). Phys. Rev. D 8: No. 4, 1067-1076 (15 Aug 1973).

The coefficients of the Wick expansion relating ordinary operator products to normal products define the transformation taking the single–time Tamm–Dancoff τ–function recursion equation into the new Tamm–Dancoff (NTD) ϕ–function recursion equations. It is shown that the ϕ–function transformation can be constructed from the ground–state τ–function recursion system for the harmonic oscillator, and that an infinite number of other energy–level–dependent transformations can be constructed in the same way. The latter allow for the development of a level–dependent NTD method permitting the accurate determination of transition frequencies through an accumulative level–by–level procedure, assuming knowledge of the ground-state energy. For the sample systems considered, the procedure is self-contained and self-consistent, the ground-state energy can be deterimined within the context of the NTD method. Numerical results are obtained for several one-dimensional nonlinear oscillators. (auth)

4392 THE CLEBSCH-GORDAN COEFFICIENTS OF SU(3) AND THE ORTHOGONALIZATION PROBLEM. Majumdar, S.D.; Basu, B.K. (Department of Physics, Indian Institute of Technology, Kharagpur, India). J. Math. Phys. (N.Y.) 14: No. 9, 1248-1253 (Sept 1973).

The Clebsch-Gordan coefficients of the group SU(3) are determined by integrating the product of three matrix elements of finite transformations belonging to three irreducible representations of the group. Compact expressions involving a single or a double sum over products of 3-j and 6-j symbols of SU(2) are obtained for several different classes of coefficients by suitably restricting the initial states but keeping the final states of the matrix elements arbitrary. To orthogonalize the CG coefficients, a linear combination of several integrals with the same final but different initial states is taken. The coefficients of the linear combination are determined by the Schmidt procedure and are found to be expressible in terms of integrals of the same type. (auth)

4393 $\mathrm{sl}_{4,R}$ AS A SPECTRUM-GENERATING ALGEBRA FOR THE COULOMB SYSTEM. Boyer, C. P.; Wolf, K. B. (Universidad Nacional Autonoma de Mexico, Mexico City). Lett. Nuovo Cim.; 8: No. 7, 458-460(13 Oct 1973).

A new construction based on a deformation of the algebra i^2O_4 and the second-order symmetric tensors built out of the Fock sphere coordinates is proposed. (JFP)

4394 APPLICATION OF A REPRESENTATION OF QUANTUM MECHANICS USING FUNCTIONS IN PHASE SPACE. Huguenin, P. (Univ., Neuchatel, Switzerland). Z. Naturforsch.; 28a: No. 7, 1090-1098(1973). (In French).

The Weyl-Wigner transformation enables one to construct a representation of quantum motion equations using functions in phase space. The states of the system are determined by the quasi-probability distribution in phase space and the motion is described by an orthogonal integral operator. This formalism is employed in the study of the classical meaning of the discrete symmetry groups, in the problem of defining the current probability and in the proving of the expression of cross section from the S-matrix. (GE)

4395 SIMULTANEOUS HYPERVIRIAL RELATIONS FOR APPROXIMATE WAVE FUNCTIONS. Katriel, J.; Domany, E. (Nuclear Research Centre-Negev, Beer-Sheba, Israel). Chem. Phys. Lett.; 21: No. 3, 448-450(1 Sep 1973).

An approximate wave function can systematically be improved by requiring simultaneous satisfaction of any set of hypervirial relations. When the operators involved form a Lie algebra, the connection between the conditions for extremum and the hypervirial relations takes a particularly simple form. For this case stability conditions are also obtained. (auth)

4396 O(4) TREATMENT OF ARBITRARY CENTRAL PROBLEM VIA QUASICLASSICAL QUANTIZATION. Serebrennikov, V. B.; Shabad, A. E. (Lebedev Inst. of Physics, Moscow). Int. J. Theor. Phys.; 7: No. 5, 339-352(1973).

A complete algebraic treatment of quantum problems with arbitrary central potential is given in terms of broken O(4) invariance. This is done within the quasiclassical accuracy. More precisely, a generalized Runge-Lenz (RL) vector is built as a nonconserving member of the O(4) Poisson brackets algebra. Its algebraic partner is the orbital momentum. The requirements imposed on the RL vector are as follows: its length is conserved, it rotates following the precession of the orbit, it vanishes for the circular motion. These requirements suffice for unique determination of the RL vector. This enables one to express the Hamiltonian of an arbitrary central problem as a function of the O(4) Casimir invariant and the angular momentum squared. The dependence upon the latter (generally very complicated) describes the way in which the symmetry is broken for a given potential. Replacing the O(4) Casimir operator and the angular momentum by their known eigenvalues results in the Bohr-Sommerfeld quantisation rules. The O(4) multiplets of energy levels free of angular momentum degeneracy are described, examples are considered, and the inverse problem is discussed. (auth)

Quantum Field Theories

Refer also to abstracts 3606 and 3633.

4397 (CERN-73-9) DIAGRAMMAR. t'Hooft, G.; Veltman, M. (European Organization for Nuclear Research, Geneva (Switzerland)). 3 Sep 1973. 119p. Dep. NTIS (U. S. Sales Only) $8.00.

Gauge theories of the quantum field are discussed featuring global diagrams as primary objects. The most important properties of the canonical as well as path integral formalisms are rederived: unitarity, causality, Faddeev-Popov determinants, etc. The starting point is always a set of Feynman rules succintly given by means of a Lagrangian. Quantum electrodynamics is used as an illustration. (JFP)

4398 (CNRS-CPT-73-P-538) COMPUTER RECOGNITION OF DIVERGENCES IN FEYNMAN GRAPHS. Calmet, J. (Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique). May 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

The program described recognizes whether or not a graph is divergent. It determines the kind of the divergences found: vacuum polarizations, electron self energies and vertices. It does not consider infrared divergences. The programming language used is REDUCE. A LISP version is also available. The nature of the divergences and their counter terms was extensively used to write down this program, therefore it is limited to the case of quantum electrodynamics. (auth)

4399 (JINR-D2-7161) NON-LOCAL QUANTUM FIELD THEORY. Proceedings of the III International Seminar Held in Alushta, USSR, April 23-30, 1973. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 280p. (In Russian). (CONF-730435-).

The Proceedings of the III International Seminar on Nonlocal Quantum Field Theory contain review talks on the problems related to nonlocal theories, theory with nonpolynomial Lagrangian, on functional methods in quantum field theory as well as on weak and strong interactions at high energies, and scale invariance. (auth)

4400 (JINR-P2-7210) "DRESSING" AND THE HAAG THEOREM. Shirokov, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

"Dressed particle" creation-distribution operators are discussed in the Lagrangian form of relativistic local quantum field theory. Using them allows one to overcome the difficulties indicated by the Haag theorem in its initial form (Haag 1955). Relying upon the Hall-Wightman form of the Haag theorem, O. Greenberg asserts that it is impossible to introduce nonfree "dressed" operators in the nontrivial relativistic theory. It is shown that the theorem is not applicable to the case under discussion because "dressed fields" turn out to be nonlocal and behave in a noncanonical manner under Lorentz transformation. (auth)

4401 (JINR-P2-7271) RELATIVISTIC KINETIC EQUATION. Semikoz, V. B.; Smorodinskii, Ya. A.; Shepelev, G. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 23p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

It is suggested to use the expansion in the 0(3,1) group when solving the kinetic equation. Simple examples of solving such equations are presented. (auth)

4402 RADIATION REACTION AND RADIATIVE FREQUENCY SHIFTS. Ackerhalt, J. R.; Knight, P. L.; Eberly, J. H. (Univ. of Rochester, NY). Phys. Rev. Lett.; 30: No. 10, 456-460(5 Mar 1973).

The question of quantum-electrodynamic radiative corrections to atomic transition frequencies is investigated. It is shown that the Heisenberg equations of motion allow a novel and fruitful exploitation of the concept of radiation reaction. (auth)

4403 COMPUTER GENERATION OF FEYNMAN DIAGRAMS FOR PERTURBATION THEORY. I. General Algorithm. Paldus, J.; Wong, H. C. (Univ. of Waterloo, Ont.). Comput. Phys. Commun.; 6: No. 1, 1-7(Jul 1973).

A general algorithm which generates all the topologically distinct, linked, non-Hartree-Fock vacuum and Green-function Hugenholtz-type diagrams is presented. Both the particle-hole and particle-particle Green-functions are considered. The one-particle Green function diagrams are not treated separately but rather obtained from the two-particle self-energy diagrams. (auth)

4404 PHYSICAL QUANTITIES AND THEIR POISSON BRACKETS IN THE CLASSICAL FIELD THEORY. Gawedzki, K. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 21: No. 6, 573-578(1973).

An abstract theory of the Poisson brackets of physical quantities of the classical field theory is developed on the basis of the finite-dimensional differential geometry. To illustrate the abstract theory results for two model field theories are presented. (auth)

4405 COMPLETENESS OF RADIAL SCHROEDINGER EQUATION SOLUTIONS AND S-MATRIX SINGULARITIES IN THE CASE

OF COMPLEX POTENTIALS. Nikolayev, M. V.; Olkhovskii, V. S. (Kiev State Univ.). Lett. Nuovo Cim.; 8: No. 11, 703-707(10 Nov 1973).

The completeness condition is obtained for eigenfunctions and associated functions of the Schroedinger equation with a complex potential, in the case when arbitrary orbital momenta occur and when twofold singularities exist. By means of this condition, the expression for the total Green's function of the radial Schroedinger equation is obtained, and it is also indicated in which way such results may be generalized to the case of arbitrary multiple singularities of the S-matrix. In addition, the physical meaning of states corresponding to the above-mentioned singularities is discussed. (LBS)

4406 EQUIVALENCE THEOREMS FOR MASSIVE SPIN-ONE PARTICLES. Kyriakopoulos, E. (CERN, Geneva). Lett. Nuovo Cim.; 8: No. 11, 713-715(10 Nov 1973).

It is pointed out that Jenkins' comments (Journ. Phys. A. 5, 705(1972)) on the equivalence theorems previously constructed by Kyriakopoulos for massive spin-one particles are due to a misunderstanding of the approach made to quantization, and that the equivalence theorem Jenkins discusses is the essence of the effective interaction Hamiltonian used in the Kyriakopoulos formalism. (LBS)

4407 FINITE QUANTUM ELECTRODYNAMICS. Pradhan, T. (Saha Inst. of Nuclear Physics, Calcutta); Lahiri, A. Proc. Indian Acad. Sci., Sect. A; 78: No. 1, 25-35(Jul 1973).

It is shown that the ultraviolet divergences encountered in the lowest order perturbation calculations of quantum electrodynamics no longer appear if the theory is expanded so as to include the mu meson, a triplet of heavy axial vector bosons and two heavy polar vector bosons in addition to the electron and photon, and suitably chosen couplings between them are introduced. (auth)

4408 ANHARMONIC OSCILLATOR. Biswas, S. N. (Univ. of Delhi). Proc. Indian Acad. Sci., Sect. A; 78: No. 1, 36-44(Jul 1973).

The quantum mechanical anharmonic oscillator is investigated since some one-dimensional model field theories of the $\lambda\phi^4$ type can be easily understood through such a study. Eigenvalues are found, and it is shown that the perturbation series for the anharmonic oscillator is just an asymptotic series in the sense of Watson. (JFP)

4409 ELEMENTARY MECHANICS FOR ULTRAFAST TACHYONS. Hamalainen, R. M. K. (Univ. of Joensuu, Finland). Joensuun Korkeakoulun Julkaisuja, Sar. B; No. 2, 1-9(1972).

The relativistic mechanics of faster than light particles is outlined. Some equations and formulas of elementary mechanics of particles with the velocity of $|u/c| \gg 1$ called ultrafast tachyons are given. Mechanics of ultrafast region can be studied according to these equations more easily than by using relativistic formulation. This is demonstrated by two examples. (auth)

4410 MINIMAL ELECTROMAGNETIC COUPLING OF SPIN-TWO FIELDS. Nagpal, A. K. (Univ. of Delhi). Lett. Nuovo Cim.; 8: No. 6, 353-356(6 Oct 1973).

The problem of the loss of some of the constraint relations in the propagation of a spin-two field equation minimally coupled to an external electromagnetic field is studied. It is found that this difficulty arises due to certain arbitrariness when introducing the electromagnetic interaction concerning operators in the free Lagrangian. This results in introducing a new kind of parameter into the interaction Lagrangian. (JFP)

4411 MANIFESTLY COVARIANT HAMILTONIAN FORM OF THE WAVE EQUATION FOR THE DIRAC PARTICLE IN THE EXTERNAL ELECTROMAGNETIC FIELD. Hanus, W.; Mrugala, R. (Inst. of Physics, Torun, Poland). Acta Phys. Pol.; B4: No. 5, 607-614(1973).

The inhomogeneous Dirac equation (depending on the potential of the external electromagnetic field) is transformed into a covariant Hamiltonian form similar to that obtained earlier for the free Dirac particle. The same procedure is extended to the case of the "amplified Dirac equation" containing additional tensor terms. (auth)

4412 LIGHT-CONE SINGULARITIES IN QUANTUM FIELD THEORY. Dietz, K. (Univ., Bonn). Nuovo Cim.; 18A: No. 1, 1-16(1 Nov 1973).

A method to determine light-cone singularities of Green's functions in quantum field theory is illustrated. From partial differential equations for the n-loop contributions to a (e.g. time-ordered) field product its light-cone singularities are derived using a procedure contrived by Hadamard. The leading nontrivial light-cone singularities of an arbitrary matrix element of the time-ordered product of two renormalized field operators in a φ^3-theory are calculated. The method can be applied to almost any "sensible" field theory. (auth)

4413 CHARGES AS GENERATORS OF UNITARY SYMMETRY GROUPS. Snellman, H. (Department of Theoretical Physics, Royal Institute of Technology, S-10044 Stockholm, Sweden). J. Math. Phys. (N.Y.) 14: No. 9, 1218-1221 (Sept 1973).

We show, that in a local field theory of the Wightman type, with an irreducible set of finitely many, relatively local field operators $\phi_k, 1 \leq k \leq n$, and a set of local, locally conserved symmetric current operators $J_i^{\mu}(x)$, the charge operators G_i that are associated with these currents are essentially self-adjoint on the domain of strictly localized states, provided the G_i:s satisfy $[G_i, \phi_k(g)] = \Sigma_{l=1}^{n} T_{kl}^{i} \phi_l(g), g \in D(\mathbb{R}^4)$, where the T^i:s are finite dimensional matrices. Furthermore when the t^i:s close to a faithful representation of a Lie algebra g, then g is finite-dimensional and compact and its representation can be integrated to a unitary representation of the corresponding Lie group. (auth)

4414 LOCAL PRODUCTS AS OPERATORS. Ruskai, M.B.; Klauder, J.R. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Math. Phys. (N.Y.) 14: No. 9, 1199-1201 (Sept 1973).

It is shown for a large class of domains that the bilinear forms associated with formal expressions of the type $\int h(x) a^{\dagger}_{sp}(x) \ldots a^{\dagger}_{s_1}(x) a^{\dagger}_{t_1}(x) \ldots a^{\dagger}_{t_q}(x) dx$ define closable operators if and only if p, $q \epsilon \{0,1\}$. (auth)

4415 STIELTJES SUMMABILITY AND CONVERGENCE OF THE PADÉ APPROXIMANTS FOR THE VACUUM POLARIZATION BY AN EXTERNAL FIELD. Graffi, S. (Department of Physics, New York University, New York, New York). J. Math. Phys. (N.Y.) 14: No. 9, 1184-1186 (Sept 1973).

It is proven that the divergent perturbation expansion of the exactly solvable vacuum polarization by an external constant electromagnetic field is Stieltjes summable. This implies the convergence of the Padé approximants to the solution. The convergence of the approximation method based on Borel summability is also proven. (auth)

4416 HEISENBERG EQUATIONS OF MOTION FOR THE CHARGED SPIN-3/2 FIELDS. Mainland, G.B.; Sudarshan, E.C.G. (Center for Particle Theory, The University of Texas, Austin, Texas 78712). Phys. Rev. D 8: No. 4, 1088-1090 (15 Aug 1973).

We show that contrary to recent claims, the Lagrange and Heisenberg equations of motion are the same for the quantized charged spin-3/2 field in the presence of a minimal external electromagnetic interaction. For dynamical systems with constraints depending upon external fields, the explicit dependence of the dynamical variables upon these external fields must be taken into account. (auth)

4417 BILOCAL LEE MODEL. Rich, M. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. D 8: No. 4, 1091-1102 (15 Aug 1973).

A modification of the Lee model is used as a simple solvable example of a bilocal field theory. Particles of bilocal fields are considered intrinsically composite, and may be thought of as a "bare" particle moving in a self-consistent, self-generated potential. Exact and perturbation solutions are given for the single V-particle state function and for the N-θ scattering matrix, and are shown to be identical. Renormalization proceeds as in the local Lee model, but is not mandatory, as all quantities are finite. (auth)

4418 IS THERE A MAXIMAL ELECTROSTATIC FIELD STRENGTH? Greenman, M.; Rohrlich, F. (Physics Department, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 8: No. 4, 1103-1109 (15 Aug 1973).

Neglecting all nonelectromagnetic interactions, nonperturbative techniques are used based on an effective quantum-electrodynamic Lagrangian. A semiclassical argument leads to a finite "classical" electron radius r_{min} of the order of $\exp[-3\pi/(2\alpha)]$ times the Compton wavelength, and to a corresponding maximal field strength $E_{max} \approx 1/r_{min}^2$ (in natural units). The charge renormalization constant Z_3 computed with the cutoff thus suggested consequently has a minimum value of $\alpha/3\pi$, corresponding to a finite bare charge. The bare mass is estimated to be of order α^2 or possibly zero. (auth)

4419 SOME SPECULATIONS ON HIGH-ENERGY QUANTUM ELECTRODYNAMICS. Johnson, K. (University of Washington, Seattle, Washington 98195); Baker, M. Phys. Rev. D 8: No. 4, 1110-1122 (15 Aug 1973).

Recent work on quantum electrodynamics is reviewed, some speculations about the theory are made, and some conceivable future experimental implications are discussed. (auth)

4420 QUANTUM FIELD THEORY IN TERMS OF SESQUILINEAR FORMS. Wyss, W. (Department of Mathematics and Physics, University of Colorado, Boulder, Colorado). J. Math. Phys. (N.Y.) 14: No. 9, 1271-1276 (Sept 1973).

We propose to describe a quantum field theory by continuous positive sesquilinear forms; using positive linear functionals would then be a special case. Our formalism still can accommodate a scattering theory. (auth)

4421 QUASISTATIONARY LEVELS IN LOWER CONTINUUM. Popov, V. S.; Mur, V. D. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 3, 684-698(Sep 1973). (In Russian).

Quasistationary levels in the lower continuum of solutions of the Dirac equation are considered. Depth of the potential V(r) is assumed to be sufficient ($|V| > 2mc^2$) for the bound states to cross the boundary of the lower continuum $\epsilon = -mc^2$ at $V = V_c$. In so doing the bound state becomes a quasistationary state whose width γ determines probability of spontaneous positron production in the static field. Behaviour of γ at the threshold $V \to V_c$ and at $V \gg V_c$ is investigated. It is shown that γ is limited even at $|\epsilon| \gg mc^2$, i.e., for a level sunken deeply into the lower continuum. For the Coulomb field $\gamma/mc^2 \sim \exp(-2\pi Z\alpha) \ll 1$. This result shows that the description of the K shell of a supercritical atom with the nuclear charge $Z > Z_c$, is valid not only at $\epsilon \to -mc^2$, but also for deep levels. The angular momentum (j) dependence of γ and analytical properties of the S matrix near $V = V_c$ are studied in detail. In particular, the case of the $p_{1/2}$ level, having some peculiar properties, is considered, as well as the s levels of a scalar particle. (auth)

4422 ALGEBRAIC CLASSIFICATION OF FIELDS AND PARTICLES. Scharfstein, H. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 8: No. 7, 443-448(13 Oct 1973).

In connection with the determination of the bilinear equal-time commutation relations between distinct fields and a new classification scheme of elementary particles a correspondence scheme between fields and particles and a schematic representation of the allowed transitions between different isomultiplets are shown, and the vacuum expectation value is evaluated. (JFP)

4423 DIMENSIONAL REGULARIZATION OF THE INFRARED PROBLEM. Gastmans, R.; Meuldermans, R. (Univ., Louvain, Belgium). Nucl. Phys.; B63: 277-284(1973).

It is shown with a simple example, the scattering of an electron in an external field, how the dimensional regularization technique can be used to handle the infrared divergences associated with real and virtual radiative corrections. It is found that the dimensionality of space-time serves as a cut-off for ultraviolet and infrared divergences, thus completely avoiding the introduction of a fictitious photon mass. (auth)

4424 CLASSICAL AND QUANTUM MECHANICS OF A ONE DIMENSIONAL RELATIVISTIC ELASTIC CONTINUUM. Takabayasi, T. (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto); 49: No. 5, 1724-1745(May 1973).

Classical theory of a relativistic string is formulated based on the parameter representation $x_\mu = x_\mu(\sigma,\tau)$ for the world strip swept by its motion. The necessity of the physically unambiguous interpretation of this many-time formalism requires certain conditions. Invariance under the scale transformation of parameters is stressed. The physical meaning of τ is clarified. Besides the equation of motion and boundary condition which follow from the variational principle additional constraint equations are needed to ensure a well defined model without tachyonic solutions. The quantization of this classical theory is made in the usual way in the Heisenberg picture with respect to τ. Then by going over to the Schrödinger picture the parameter τ is automatically eliminated and one is left with a wave equation alone. Moreover this equation and the constraint equation are incorporated into a single "detailed wave equation", which was given previously as the fundamental equation of the quantum mechanics of a relativistic string. The case of external interaction is briefly treated. (auth)

4425 THIRRING MODEL WITH U(n) SYMMETRY: SCALE INVARIANT ONLY FOR FIXED VALUES OF A COUPLING CONSTANT. Dashen, R.; Frishman, Y. (Inst. for Advanced Study, Princeton, NJ). Phys. Lett.; 46B: No. 3, 439-442(1 Oct 1973).

Generalizations of the Thirring model to Fermi fields with U(n) symmetry are treated. When interactions quadratic in the SU(n) currents are introduced, scale invariance (with anomalous dimensions) is maintained only for values of the coupling $g_v = 0$ or $g_v = 4\pi/(n+1)$. (auth)

4426 GROUP STRUCTURE OF THE RELATIVISTIC EQUIVALENT OSCILLATOR. Chaffin, E. F. (Oklahoma State Univ., Stillwater). J. Math. Phys. (N. Y.); 14: No. 7, 977-979(Jul 1973).

The Dirac Hamiltonian with an equivalent oscillator potential introduced by Swamy is discussed from the point of view of group theory. It is shown to possess an $SO(4) \times SU(2)$ invariance group and an $SO(4,1) \times SU(2)$ noninvariance group. (auth)

4427 ALGEBRA OF THE YANG–MILLS FIELD. Buoncristiani, A. M. (Ohio State Univ., Columbus). J. Math. Phys. (N. Y.); 14: No. 7, 849-854(Jul 1973).

It is shown how the classical Yang–Mills (and the Maxwell) field equations can be written in a simple form by introducing differential operators based on the split-Cayley algebra. As a result, a field algebra accommodating both space–time symmetry (Lorentz invariance) and internal symmetry evolves. The connection between the view of the Yang–Mills field as a split-Cayley algebra and the exceptional Jordan algebra M_3^8, discovered by Jordon, von Neumann, and Wigner, is discussed. (auth)

Gravitation and General Relativity

4428 (IC-73/120) STATIC FLUID SPHERES IN EINSTEIN–CARTAN THEORY. Prasanna, A. R. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

Using Trautman's recent formulation of Einstein-Cartan equations, a few solutions for static spheres composed of a perfect fluid of spinning particles were obtained. It was found that a space-time metric similar to Schwarzschild's interior solution will no longer represent a homogeneous fluid sphere and the equation of state has p going as $\rho + \rho$ + a const. In the case of the solution where $p_0/\rho_0 \to \frac{1}{3}$ the condition that the spin is real sets in a natural restriction on the mass to radius ratio m/a. In these two cases it was found that the metric potentials are not of class C^1. (auth)

4429 (INIS-mf-795) QUATERNIONS AND RIEMANN AND NON RIEMANN SPACE–TIME. do Amaral, C. M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1971. 115p. (In Portuguese).

Thesis.

Space–time analysis by the quaternions algebra of the four-dimensional Riemann and non-Riemann varieties is studied. Einstein's gravitational equation is obtained. Non-Riemann varieties are obtained by direct product of Clifford-Pauli algebras. Particular case of a uniform torsional space is treated and the Weyl's equation is obtained in the quaternions space-time. (auth)

4430 GRAVITATIONAL RADIATION DAMPING OF THE SPINNING ROD FOR ARBITRARY ROTATIONAL SPEED. Frehland, E.; Nowotny, E. (Konstanz Univ., Ger.). Int. J. Theor. Phys.; 7: No. 6, 443-449(1973).

Within linearized general relativity the energy loss of the spinning rod due to its gravitational radiation damping is calculated numerically for arbitrary rotational speeds. Comparison shows that the classical low velocity approximation is good until rotational speeds of the ends of the rod of about ⅓ of the velocity of light. (auth)

4431 CAN SPIN AVERT SINGULARITIES? Stewart, J.; Haijicek, P. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nature (London) Phys. Sci.; 244: No. 136, 96(6 Aug 1973).

It has been suggested (Trautman Nature Phys. Sci. 242: 7 (1973)) that the introduction of intrinsic spin effects into general relativity through the Einstein–Cartan torsion theory may avert a gravitational singularity. It is suggested that the singularity is avoided only because of the high symmetry of the model used. Unless the universe is very isotropic, a singularity cannot be avoided in the way suggested by Trautman. (UK)

4432 EXPANSION-FREE KERR–SCHILD FIELDS. Debney, G. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Lett. Nuovo Cim.; 8: No. 6, 337-341(6 Oct 1973).

The expansion-free Kerr–Schild fields are studied starting with the general Kerr–Schild metric in a vacuum space–time. (JFP)

4433 NEW APPROACHES TO STATISTICAL DYNAMICS OF GRAVITATIONAL SYSTEMS. Jehle, H. (Physics Department, George Washington University, Washington, D. C. 20006). Phys. Rev. D 8: No. 4, 991-1009 (15 Aug 1973).

It is pointed out that equations of motion (i.e., the continuity equations and the Euler-Bernoulli equation for the motion of a system of particles in gravitational interaction) are best and most advantageously formulated in terms of a Schrödinger-type equation in which the h^3 characterizing the uncertainty principle is replaced by a macroscopic phase-space volume which characterizes the coarse-grainedness of the mass distribution in phase space. This method is applied to the study of a gravitational system of the type of our solar system in its recent development, as the present system is assumed to be preceded by a system of a large number of smaller particles in gravitational interaction. The distribution of orbital elements of the planets in the solar system, and also of the elements of the satellites of the major planets, show distinct regularities. One of them, the commensurability of the periods of revolution, has been repeatedly discussed. Another, the small eccentricities and inclinations, has found a simple explanation in the Kant–du Ligondès hypothesis of the development of the solar system. Still another one, concerning the distribution of the semimajor axes (or periods), has found a numerological formulation in the Titius-Bode "law," and its explanation has been attempted in terms of a distribution of vortex rings in the early stage of the Kant–du Ligondès model. We are here proposing a simpler analysis of the regularities in this distribution of the semimajor axes. It is suggested that statistically there are changes toward preferential orbital elements due to the gravitational interaction in such a system. Instead of discussing the issue in terms of perturbation expansions of individual orbits, however, it may be more advantageous to pursue the analysis in terms of the statistical distribution of integrals of the equations of motion, in particular the Jacobi integral. These distributions of the integrals (orbital elements) are most elegantly formulated in terms of distributions of the stationary–state wave functions which correspond to those integrals. The calculations yield, for the planets and for the satellites, sequences of orbital elements which coincide strikingly well with the observed elements. (auth)

4434 INVARIANT MAPPINGS AND CLASSICALLY CONSERVED QUANTITIES. Komar, A. (Belfer Graduate School of Science, Yeshiva University, New York, New York 10033). Phys. Rev. D 8: No. 4, 1028-1030 (15 Aug 1973).

We determine the properties of the most general (infinitesimal) mapping in phase space which preserves a congruence of classical trajectories. Although such mappings need not be canonical, we find that they can nevertheless be associated in unique fashion with constants of the motion. The application of these results to the problem of determining the observables of the general theory of relativity is indicated. (auth)

4435 THE GRAVITATIONAL INFLUENCE OF A BEAM OF LIGHT. I. Nackoney, R.W. (Physics Department, University of Chicago, Chicago, Illinois 60637). J. Math. Phys. (N.Y.) 14: No. 9, 1239-1247 (Sept 1973).

In this paper an exact solution is provided for the Einstein field equations of a beam of light. The beam is circular in cross section, infinite in length and duration, and considered in the geometrical limit with the flux being a function of only the radial coordinate. Null and timelike trajectories of this metric are considered in two classes: those with and without angular motion around the circular beam. The elements of the beam are initially without angular or radial motion and are found to follow a set of null trajectories which allows the beam to be in a state of equilibrium. A null trajectory, without angular motion, which is initially inclined slightly to the direction of the beam will curve away from the beam. Such a trajectory will continue to curve away until it is directed perpendicular to and then opposite to the beam direction, thereupon coming back into the beam upon the mirrored outgoing trajectory. Such trajectories are discussed with emphasis upon Lorentz transformations along the direction of the beam. Trajectories with angular motion include orbital cases. Beams of sufficient energy flux may allow closed null orbitals and regions of stable and unstable closed timelike orbits. Null helical trajectories which spiral back along the length of the beam can always occur; however, forward spiraling trajectories are restricted to large fluxes and are discussed in the light of Lorentz transformations. (auth)

4436 ONE–LOOP CORRECTIONS TO TREE DIAGRAMS. Sarkar, S. (Physics Department, Imperial College, London S.W.7., England). Phys. Rev. D 8: No. 4, 1060-1067 (15 Aug 1973).

Motivated by quantum gravity (where multiloop and in particular one–loop corrections pose large problems) we study the zero–space dimension ψ^4 model. A nonperturbative solution in the one–loop approximation for the relative vacuum amplitudes is obtained. This amplitude is found to be nonanalytic in λ. This has possible implications for the gravity–modified quantum electrodynamics as proposed by Salam. The gravity Green's functions (at least the two–point functions) have a logλ–type behavior. We discuss why it is plausible that summation over all orders in perturbation theory may change this logλ dependence. We use an approximate connection between the Schwarzschild radius of the electron and the behavior in λ to suggest plausible effects of quantum–loop corrections on the Schwarzschild solution. (auth)

4437 OSCILLATORY BEHAVIOR OF CHARGE–MATTER FLUIDS WITH $e/m > G^{1/2}$. Bailyn, M. (Department of Physics, Northwestern University, Evanston, Illinois 60201). Phys. Rev. D 8: No. 4, 1036-1044 (15 Aug 1973).

It is shown that the exact solutions of the spherically symmetric time–dependent pressure–free Einstein–Maxwell equations with external $e/m > G^{1/2}$ allow steady–state oscillatory behavior but only under the same conditions that were found previously to be necessary for equilibrium in the static case, namely (1) that a divergence exists in g_{44} at the center, (2) that the matter density is negative, at least near the center, and (3) that the ratio of charge to matter density is not constant. (auth)

4438 A GEOMETRIC GENERALIZATION OF HOOKE'S LAW. Glass, E.N. (Department of Physics, University of Cincinnati, Cincinnati, Ohio 45221); Winicour, J. J. Math. Phys. (N.Y.) 14: No. 9, 1285-1290 (Sept 1973).

A geometrical version of Hooke's law for prestressed materials is established using techniques suggested by general relativistic elasticity theory. The concept of dragged (D) tensor fields is used to present a simple coordinate independent form of Hooke's law for prestressed materials: $\bar{P}^{ij} = D\,P^{ij} + C^{ijkl}\,\eta_{kl}$, where P^{ij} is the initial stress, C^{ijkl} are the second order elastic coefficients, and η_{kl} is the strain. The effects of initial stresses on Hooke's law have recently been given empirical significance by Wallace and the work here agrees with and simplifies his formalism. The elastic behavior of neutron stars, which requires a general relativistic treatment, is a case in which large prestresses of the type considered here are as important as the elastic moduli themselves. The version of Hooke's law developed here is the classical limit of the general relativistic theory of stellar elasticity. A simple derivation of the seismic response of a Newtonian self–gravitating body to elastic perturbations is presented. (auth)

4439 MATTER SYMMETRIES IN GENERAL RELATIVISTIC KINETIC THEORY. Berezdivin, R. (University of California, Berkeley, California); Sachs, R.K. J. Math. Phys. (N.Y.) 14: No. 9, 1254-1257 (Sept 1973).

It is shown that a surface forming matter symmetry for collision–free general relativistic kinetic theory gives rise to an isometry on the space–time. Specific solutions are given, and it is shown that limiting the surface forming conditions to the mass subbundle does not alter the results. A possible method for solving more general cases is given. (auth)

4440 ANALYSIS OF THE OPTICAL AND ELECTROMAGNETIC PROPERTIES OF GRAVITATIONAL FIELDS IN GENERAL RELATIVITY. Borochoff, R. T. Houston, TX; Univ. of Houston (1973). 103p. University Microfilms Order No. 73-22,893. Thesis (Ph. D.).

From first principles of electromagnetism, a formalism analogous to that of classical optics is developed for an analysis of stationary metric fields as optical media. In the geometric approximation, stationary metrics are shown to generate Fresnel surfaces without centers of inversion; it is shown that no material free gravitational field can display birefringence, nor can it generate a "forced birefringence," of a relativistic nature, in isotropic material introduced into the field. For the ray path, the Frenet triad, the curvature and the torsion are all calculated both for an arbitrary weak field and a spatially isotropic strong field; also, at the same approximation level, the equation for the deflection of the ray path is given for the above two metric classes. At the next level of approximation, the transport equation for the vector fields is presented. This equation demonstrates that a "polarization rotation" exists for certain metric fields. A corresponding equation is developed from a purely geometric analysis of a curve on a surface. Since the question is in dispute, concerning whether or not a rotation of the polarization plane takes place for light propagating between infinite limits past a rotating spherical body, this system is studied as a practical example. The finding is in the negative; however, a small positive effect is found for light originating on or in the vicinity of the surface of the body. This finding helps resolve the conflicting results obtained by G. V. Skrotskii and J. Plebanski. This work, by an independent method, has obtained a result which agrees with Plebanski. (Diss. Abstr. Int., B)

4441 GRAVITATIONAL SELF-INTERACTION OF THE CLASSICAL SCALAR FIELD. Ranada, A. F. (Univ. of Zaragoza, Spain); Soler, M. Lett. Nuovo Cim.; 8: No. 7, 421-424(13 Oct 1973).

The Lagrangian of the scalar field is considered for the study of the gravitational self-interaction of the classical scalar field. Equations of motion are found, and the theorem that in the Minkowsky limit the mixed theory of the coupled gravitation and scalar limit based on the given Lagrangian is equivalent to a given metric theory is proven, (JFP)

4442 OBSHCHAYA TEORIYA OTNOSITEL'NOSTI POSLE EINSHTEINA. (General Theory of Relativity After Einstein). Gurevich, L. E.; Gliner, E. G. Moscow; Izdatel'stvo Zhanie (1972). 63p.

Actual problems in the development of the general theory of relativity in the period after the death of Einstein are considered. Particular attention is paid to gravitational collapse and cosmology. The basic concepts were presented with a minimum of mathematics. The following concepts are expounded: noneuclidean geometries, space-time representations, measuring the "length" of a world line by a clock, intervals and coordinates, interval as an invariant of space-time geometry, Lorentz transformations, unattainability of the velocity of light, no space but only space-time, connection between the special and general theories of relativity (casuality), what is the geometry of the general theory of relativity, curvature tensor, law of free fall, three noticeable effects (curvature in the orbits of mercury, venus and the earth around the sun, deflection of light rays near the sun and of radio-rays from quasars 3C273 and 3C279, and the red shift of spectral lines because of the change in photon energy under the effect of gravity, confirmations of the theory, expansion of the universe, homogeneous model of the universe, Friedman cosmology, gravitational collapse, and space-time of Schwartzshild. (SJR)

4443 IS QUANTUM GRAVITY AMBIGUITY-FREE? Isham, C. J. (Imperial Coll. of Science and Tech., London); Salam, A.; Strathdee, J. Phys. Lett.; 46B: No. 3, 407-411(1 Oct 1973).

The ultraviolet behavior of Green functions in field theories with a local gauge symmetry is, to some extent, gauge dependent. This is due to the intervention of ghost-like gauge degrees of freedom. It is argued that it may be possible, in the case of non-polynomial gauge theories, to find a class of gauges in which all ultraviolet divergences and their attendant ambiguities are suppressed. (auth)

4444 EQUIVALENCE PRINCIPLE AND THE PREDICTIONS OF EINSTEIN'S FIELD EQUATIONS. Sen Gupta, N. D. (Tata Inst. of Fundamental Research, Bombay). Phys. Lett.; 44A: No. 4, 265-266(18 Jun 1973).

It is shown that the proper incorporation of the equivalence principle in the relativistic equation of motion leads to the correct predictions of the results in a gravitational field according to the general theory of relativity. (auth)

4445 PETROV CLASSIFICATION OF CLASS TWO SPACE-TIMES. Singh, K. P.; Ram, S. (Banaras Hindu Univ., India). Indian J. Phys.; 47: No. 6, 355-363(Jun 1973).

The Petrov classification of the space-times of class two is considered. It is found that the metrics are either of Petrov type I or Petrov type II. (auth)

4446 RADIAL WAVE EQUATION IN SCHWARZSCHILD'S SPACE-TIME. Persides, S. (Univ. of Thessaloniki, Greece). J. Math. Phys. (N. Y.); 14: No. 8, 1017-1021(Aug 1973).

The radial factor of a separable solution of the wave equation in Schwarzschild's space-time satisfies a second-order linear differential equation. This equation is studied in detail. The behavior of the solutions near the singular points (the origin, the horizon, and infinity) of the equation is analyzed. By an appropriate transformation two simpler differential equations are obtained corresponding to retarded and advanced solutions with characteristic asymptotic expansions. Their properties permit the expression of the general solution of the radial equation in terms of a single contour integral. Finally, through a "matching" technique, the behavior of a solution at the singular points is determined from its behavior at a single singular point. (auth)

4447 NOTE ON THE SATO-TOMIMATSU SOLUTION OF EINSTEIN'S EQUATIONS. Gibbons, G. W.; Russell-Clark, R. A. (Cambridge Univ., Eng.). Phys. Rev. Lett.; 30: No. 9, 398-399 (26 Feb 1973).

An examination of the Sato-Tomimatsu solution shows it to represent a spinning naked singularity with causality violation and a singular ergosphere. It does not contain an event horizon. (auth)

4448 ISOSPINORS. Maia, M. D. (Univ., Brasilia, Brazil). J. Math. Phys. (N. Y.); 14: No. 7, 882-887(Jul 1973).

A spinor structure which is covariant under a representation of the groups of isometries in general relativity is defined. The relation of isospinors with space-time objects is investigated, and their use in describing elementary particles in general relativity is discussed. (auth)

REACTOR TECHNOLOGY AND REGULATION

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 4563, 4569–4572, 4574–4576, 4581, 4584, 4585, 4587–4598, 4602–4607, 4614–4624, 4635, 4636, 4638, 4647, 4649, 4652, 4653, and 4655–4665.

4449 (BMFT-FBK-73-6) INFLUENCE OF THE STANDARDIZATION OF FUEL ELEMENTS ON THE SAFETY AND ECONOMICS OF NUCLEAR POWER STATIONS. Ritig, D. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany)). Apr 1973. 66p. (In German). Dep. NTIS (U. S. Sales Only) $5.50.

The fuel elements of the various types of reactors have achieved a certain perfection, based on current standards of technology. The immediate future will not show an economical advantage for such fuel elements unless money is put into development. Standardization is considered as a subsequent stage of the development of a proven system. Based on the current market trend it is assumed that 90% of the nuclear-powered plants commissioned between 1978 to 1984 will be powered by light-water reactors. In this category 60% of the pressurizing reactors and 40% of the boiling water reactors are included. Standardized fuel elements are used throughout the life of the reactors. It is shown that in order to cover the demand for fuel elements, several cheap manufacturing sources are necessary. Because of the repeated manufacture of the unchanged products, their manufacture is subject to a definite "learning process". The economic effects of this learning process on the manufacturing costs of the fuel elements, fuel cycle, and power are demonstrated. The resulting saving in costs during the whole service period of the reactors having standardized fuel elements is indicated. Considering the fact that no specific investments are necessary the saving is considerable. The problems of fuel element manufacture and testing are discussed in order to show that the "learning process" has in fact a real background. (auth)

4450 (CONF-730942-, pp vp PAPER C 1/8) MATHEMATICAL TREATMENT OF THE MECHANICAL DENSIFICATION OF REACTOR FUEL. Rashid, Y. R.; Tang, H. T.; Johansson, E. B. (General Electric Co., San Jose, CA). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The general phenomenon of mechanical densification of uranium oxide fuel pellets, usually referred to as hot pressing, is characterized by plastic volume change exhibited by the fuel during reactor operations. Much of the fuel behaviour under instantaneous plastic flow and creep, including crack healing and fuel redistribution, can be related analytically to hot pressing. The general problem of the elastic-plastic-creep behavior of light water reactor fuel is examined by first describing a mathematical model for the material's instantaneous and time dependent inelastic response. Then a method for conducting out-of-reactor experiments for evaluating the model's parameters is described. An incremental stress-strain relation which can be used in structural analysis is derived. (auth)

4451 (CONF-730942-, pp vp PAPER C 3/2) STRESS TREATMENT OF FISSURED FUEL IN EVENT OF MECHANICAL INTERACTION WITH THE CANNING OF LWR FUEL RODS AS A RESULT OF POWER EXCURSIONS. Depisch, F. (AEG-Telefunken, Frankfurt am Main); Goebel, D.; Guse, K.; Eibel, H. 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

To calculate mechanical interaction caused by power ramps in LWR, especially in BWR fuel rods, it was necessary to modify the fuel pin modeling code SATURN-1, which was originally developed for fast breeder fuel. In the majority of power conditions in BWR fuel the presence of cracks has to be taken into consideration in calculating the mechanical interaction. The fuel is therefore treated as a three zone model with respect to stress distribution: the central zone can become hydrostatic, the bridging zone, where all cracks are healed up, and the outward cracked zone consists of rigid pieces with free heat and swelling expansion. The cladding is in interaction with the bridging zone in the fuel by use of two boundary conditions. The numerical results show up that not alone the size of the power ramp determines the deformation of the cladding but also the steady state power level. The steady state power level influences as well the distribution of the cracks and therefore the stiffness of the fuel, as the ability of stress relaxation in the fuel. It is demonstrated that the amount of mechanical interaction depends strongly on whether the axial expansion of the fuel is free or not. The canning is loaded by additional forces in axial direction in the case of locked fuel compared to sliding fuel. Boundary conditions for locked and sliding fuel were established in the code. The calculation yielded that with sliding fuel the stresses are reduced in the cladding by mechanical interaction almost to the half as compared to locked fuel. (auth)

4452 (CONF-730942-, pp vp PAPER C 3/4) THERMO-ELASTIC STRESSES IN FUEL ELEMENT CLADS DUE TO COMBINED EFFECTS OF FLUX TILT IN THE FUEL AND CIRCUMFERENTIAL VARIATIONS OF BOUNDARY CONDITIONS. Wolf, L. (Technische Univ., Berlin). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The analysis of fuel rod bowing and asymmetric stress distributions is presented based on the methods of classical thermoelasticity, assuming no variation in axial direction and constant material parameters. The influence of the fuel is accurately considered in the thermal analysis but disregarded in the thermoelastic analysis. The normal stress at the inner cladding surface can also vary in the circumferential direction. All parameters varying around the circumference are developed in Fourier series of which coefficients can be determined explicitly for the fuel-clad heat transfer coefficients in terms of geometrical parameters. Calculating the axial stress component three different types of end conditions are considered: plane strain, unrestrained case, resultant axial force due to the difference of the reactor system pressure. The mathematical background and results are presented for typical BWR, PWR and LMFBR conditions. One of the results is, that the flux tilt has not great influence under LWR conditions, whereas this effect is more pronounced for LMFBR's. The stress distributions are much more influenced by changes of the inner geometry. The results may serve as an upper limit due to the neglection of time dependent phenomena and are therefore limited to some extent to the start-up phase of a reactor. (auth)

4453 (CONF-730942-, pp vp PAPER D 1/1) MATHEMATICAL MODELING AND ANALYSIS OF FUEL RODS. Rashid, Y. R. (General Electric Co., San Jose, CA). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The major structural constituents of light water reactor fuel rods, namely, the uranium oxide cylindrical pellets and the zirconium alloy cladding, undergo highly complex deformation histories during reactor operations. The degree to which one understands such deformation histories determines to a great extent the quality and reliability of fuel rod future designs. The solution of this general problem requires the development of material behavioral models and analysis methods capable of following the reactor's power histories and predicting the response of the fuel rod to the transient, as well as the steady state, loading regimes that may be imposed on the rod by such power histories. A comprehensive method of analysis is presented by first developing appropriate constitutive relations for the fuel and the clad materials that take into account elastic-plastic behavior, primary as well as secondary creep, mechanical densification (hot pressing), fuel swelling, fuel cracking and healing, and fuel redistribution. The geometric problem will be treated on the basis of a two-dimensional, axisymmetric and plane, model within the frame-work of the finite element method. General power histories of the transient, cyclic, and steady state types will be considered. The shortcomings of inadequate material descriptions and numerical difficulties resulting from high creep rates, fuel cracking and rapid changes in power histories will be examined. Methods for using the analytical model as a companion guide to material characterization experiments will be discussed. Finally, analysis results uncovering the importance of certain deformation processes and comparisons with experiments are given. (auth)

4454 (CONF-730942-, pp vp PAPER D 1/2) CREEP ANALYSIS OF A FUEL ROD AXIAL RATCHETTING. Kim, S. B. (Atomic Energy Commission, Washington, DC). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The axial ratcheting problem of a fuel rod in a light water reactor is considered. A mathematical model is derived to simulate the physical behavior. It is assumed that time history of radial contact and separation between fuel and clad are known beforehand. Subsequent axial movements due to power cycles are described by means of a set of first order ordinary differential equations. Displacements at each contact point as well as forces are calculated as a function of time. All the material constants are functions of temperature and hence vary with time through-out the history. Creep constants are a function of irradiation as well as temperature. The fuel and clad are subdivided into several spans along the length and both are fixed at the bottom. Forces are assumed to be constant within a span and since no bending is considered the analysis is geometrically one-dimensional. The number of contact points constitute degree of governing differential equations as well as a number of simultaneous equations. It was found that at the beginning of life the top-most contact point experienced the highest force and being gradually reduced toward the bottom. Subsequent time dependent behavior of the ratcheting is quite sensitive to the creep constants of the fuel and clad. It ranges from almost no relaxation of the forces to reversing from tension forces to compression. The result was obtained by means of time increment solution of first order finite difference scheme. (auth)

4455 (CONF-730942-, pp vp PAPER D 1/3) GENERALIZED APPROACH TO MODELING THE INTEGRATED EFFECTS OF RATCHETTING IN FUEL RODS. Colemen, D. C.; MacDonald, P. E. (Nuclear Fuel Services, Inc., Rockville, MD). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

A fuel rod ratchetting model and supporting data are described in which radial and axial deflections occur over fuel and cladding length increments where mechanical interactions have taken place. Two concepts were developed: a local "effective gap" which incorporates localized pellet cracking and cocked pellet locking effects; and an "interaction length" defined as an axial segment of the rod where the effective gap at the top and bottom becomes negative. Appropriate allowances are made to account for fuel and cladding restructuring and accompanying stress relaxation in both the axial and radial (effective gap) directions. Six miniature differential transformers were used to measure cladding elongation at power in the Halden Boiling Water Reactor. Comparisons of measured and calculated early life cladding elongations are shown for rods of various fuel densities and initial gaps. Favorable agreement for three successive full power cycles over a period of about 260 hours demonstrates the applicability of general assumptions consistent with a macroscopic treatment of the mechanisms involved and their cumulative effect on overall fuel rod dimensional behavior. 5 references. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 4449–4454, 4520, 4522, 4564–4568, 4573, 4577–4580, 4582, 4583, 4586, 4599–4601, 4608, 4610–4613, 4625–4634, 4637, 4639–4646, 4648, 4650, 4651, 4654, and 4666.

4456 (EUR-5037) ARDENNES NUCLEAR POWER PLANT. Annual Report, 1972. (Societe d'Energie Nucleaire Franco-Belge des Ardennes, 08–Chooz-lez-Givet (France)). Oct 1973. 50p. (In French). Dep. NTIS (U. S. Sales Only) $4.50. EUR FB 60,-.

The Ardennes Nuclear Power Plant ends, in 1972, its second year of full industrial operation, characterized by the following statistics: net energy produced: 2032 GWh; number of hours coupled: 7471 h; availability coefficient: 83.9%; total number of shutdowns; 10; number of scrams: 2; and cost of kWh: 4.24 French centimes. The plant's operation is in general very satisfactory. The modifications made in 1971 distinctly improved the reliability of the reactor's safety devices and the overall behavior of the installation. (auth)

4457 (WCAP-5727) HIGH PRESSURE ROD BUNDLE DNB DATA WITH AXIAL NON-UNIFORM HEAT FLUXES. Cermak, J. O.; Rosal, R.; Tong, L. S.; Casterline, J. E.; Kokolis, S.; Matzner, B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA); Columbia Univ., New York (USA). Dept. of Chemical Engineering). [nd]. 41p. (CONF-731020-1). Dept. NTIS $4.25.

From international heat transfer meeting; Karlsruhe, F. R. Germany (9 Oct 1973).

An extensive experimental program was performed to investigate the behavior of Departure from Nucleate Boiling (DNB) in electrically heated rod bundles simulating a portion of a nuclear power reactor assembly. Effects on DNB due to non-uniform axial heat flux distribution, geometry of spacer grids (with and without mixing vane), length, and axial grid spacing along the rod were investigated. The 284 DNB data points obtained were compared with DNB heat fluxes predicted by the non-uniform heat flux W-3 correlation with spacer factor. The spacer factor accounts for the grid spacer effect in a correlation originally developed from single channel data. The predicted DNB heat flux values were based on local conditions calculated by the THINC computer code. The results verified that this correlation can accurately predict (7.3% standard deviation +2.4% deviation of predicted mean from data average) the DNB heat fluxes in axially non-uniform heat rod bundles. (auth)

4458 (WCAP-7912(Suppl.1)) POWER PEAKING FACTORS. McFarlane, A. F.; Langford, F. L. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Sep 1973. 52p.

Information requested by the AEC Division of Regulation concerning power peaking factors in Westinghouse PWR type reactors is presented. The format is in question-answer form. (JWR)

4459 (WCAP-7980) WIT-6 REACTOR TRANSIENT ANALYSIS COMPUTER PROGRAM DESCRIPTION. Hargrove, H. G. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Dec 1972. 18p.

The WIT-6 code uses a standard neutron-point, kinetics core model with a single-axial, lump description of thermal kinetics, the thermal kinetic equations being reduced to a first order integration. The code models a heterogeneous core consisting of fuel rods, fuel rod cladding, and water moderator and coolant. A complex iterative technique is used to solve the equations for neutron density and delayed neutron precursor concentration. The code is generally useful for fast reactivity transients which terminate before significant effects occur from the remainder of the plant, i.e., transients shorter than the loop transit time. The code prints out fuel, clad and water temperature, power, heat flux and multiplication factor. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 2993, 4558, and 4609.

4460 (CONF-730942-, pp vp PAPER C 1/1) STATUS OF MODELS DESCRIBING THE MECHANICAL PERFORMANCE OF COATED PARTICLE FUELS. Hick, H. (Atomic Energy Establishment, Winfrith, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The evolution of coated particle stress models is reviewed. The basic physical assumptions underlying all models published so far have remained the same and are limiting their area of applicability (agreement with experimental observations) to low fast neutron dose levels and steady state irradiation conditions. The most serious limitation is due to the assumption of mutual independence of the various physical processes which are combined in the constitutive equation. Irradiation-induced dimensional change data which have been obtained for an unrestrained specimen are assumed to apply in exactly the same way to all finite zones within a PyC coating layer, while experimentally it has been shown that zones of originally identical PyC characteristics develop different microstructures (anisotropies) according to their individually different irradiation (stress-strain) histories. It is therefore proposed to include a feed-back loop containing a PyC model in the structure of the stress models so that the material data for individual zones could be updated according to their irradiation histories. 35 references. (auth)

4461 (CONF-730942-, pp vp PAPER C 1/2) "CORMORAN" AN EXPLICIT CODE FOR CALCULATING STRESSES AND DEFORMATIONS IN HTR PARTICLES. Morgand, P. (CEN, Grenoble, France); Lanier, J.; Boulon, M. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

CORMORAN is founded on the following main hypotheses: pyrocarbon and silicon carbide are isotropic from an elastic point of view; their elastic constants do not change during irradiation; the pyrocarbon creep law is isotropic with a Poisson's coefficient which may introduce a volume change; and fast fluence induces an anisotropic dimensional change into pyrocarbon. From these hypotheses, the tangential and radial elongations of pyrocarbon are written as a function of the tangential and radial tensile stresses. Introducing them into the compatibility and equilibrium equations yields two explicit relations giving the tensile stresses as a function of the radius and of the fast fluence. These relations contain two unknown functions of the fast fluence which are fixed by the boundary conditions. Two versions of CORMORAN have been elaborated, the TRISO and the BISO versions, the two differing through the calculation of the free volume allowed for the fission gases. 8 references. (auth)

4462 (CONF-730942-, pp vp PAPER C 1/3) VERIFICATION OF STRESS CALCULATIONS FOR COATED FUEL PARTICLES BY A SPECIFIC IRRADIATION EXPERIMENT. Bongartz, K. (Kernforschungsanlage, Juelich, Ger.); Hougaard, H. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

A specific irradiation experiment has been performed to test a mathematical model for calculation of stresses in coating layers of fuel particles for a high-temperature reactor. The stresses are induced mainly by the internal fission gas pressure and the fast dose induced dimensional changes of the coating material. High stresses can lead to breakage of the PyC- and SiC-coating layers, which results in unwanted release of fission gases. The aim of the model is to provide evidence on the mechanical behavior during irradiation and predict the lifetime (irradiation time until breakage) of a coated particle. In order to get proof on the validity of the model an extensive irradiation experiment was carried out. The layout of the experiment was based upon earlier model calculations. (auth)

4463 (CONF-730942-, pp vp PAPER C 1/4) ASSESSMENT WITH THE CODE COCONUT OF THE BEHAVIOUR OF HTR COATED PARTICLES IN DIFFERENT IRRADIATION EXPERIMENTS. Thomson, J. M. (Belgonucleaire, Brussels). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The code COCONUT solves analytically the stress problem in a multilayer coated particle. The first part of the code calculates the stresses and strains in the kernel and the different layers during the coatings deposition in the fluidized bed and deduces the dimensions and gaps after fabrication. The second part of the code calculates the stresses and strains during irradiation. It takes into account the fission gases and carbon monoxide pressure, the kernel swelling and the temperature and irradiation dependent dimensional changes. It goes through successive time steps and corrects the calculated stresses and strains for the irradiation induced creep. The code has been used to predict the behaviour of coated particles in the four irradiation experiments: the VC-1 and VC-2 experiments in the BR2, the Inter 1 and Inter 3 experiments in the Dragon reactor. 3 references. (auth)

4464 (CONF-730942-, pp vp PAPER C 1/6) FINITE ELEMENT STRESS ANALYSIS OF NONSPHERICAL COATED PARTICLES. Drittler, K. (Technische Ueberwachungs-Vereine eV, Cologne); Grieger, I. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

In high temperature gas cooled reactors the fissile materials within the fuel elements are particles which are coated with several layers of substances which are capable of retaining fission products. In these layers stresses are created due to irradiation induced length changes as well as fission gas pressure. Models of coated particles which are symmetrical with respect to an axis are analyzed to study certain aspects of the influence of nonsphericity. Only the outer layers consisting of pyrolytic carbon, or a combination of pyrolytic carbon, silicon carbide and pyrolytic carbon are taken into account. It is assumed that only fission gas pressure acts upon the inner surface of these layers. The inner and outer surfaces of the first kind of models have the shape of ellipsoids of revolution. The deviation of layer thicknesses from constant values was made as small as possible. The inner surface of the second kind of models are assumed to be spherical, but by variation of the layer thickness the outer surfaces are adapted to characteristic forms often shown by manufactured coated particles. The calculations were carried out using the method of finite elements. The triangular curvilinear ring element TRIAXC6 of the code ASKA was chosen. The investigated deviations from sphericity led to stresses whose absolute values are several times higher than those calculated for particles with spherical symmetry. 3 references. (auth)

4465 (CONF-730942-, pp vp PAPER C 1/7) VISCO-ELASTIC MODELS OF DEFORMATION AND FRACTURE IN POWER-CYCLED HTR FUEL. Gittus, J. H. (United Kingdom Atomic Energy Authority, Springfields, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

Fuel elements for high temperature reactors are usually fabricated exclusively from non-metallic materials such as graphite, silicon-carbide, pyrolytic carbon and fissile ceramics (UO_2, ThO_2, PuO_2). A notional design, which incorporates most of the features of HTR fuel elements, comprises a stack of annular compacts penetrated by an inner graphite tube and contained in an outer graphite tube. Each compact is a pressed, sintered mixture of graphite powder and coated UO_2 microspheres; the coatings comprise an SiC layer sandwiched between two thicker pyrolytic carbon (PyC) layers. When such an HTR fuel element is subjected to power cycling, the endurance of the coating on the particles may be altered, the graphite tubes may be subjected to alternating stresses leading eventually to fatigue failure, and alternating stresses may be produced between the tubes and the compact. It is with these three effects that the present analysis is concerned. The analysis makes use of the theory of visco-elastic networks. (auth)

4466 (CONF-730942-, pp vp PAPER D 1/7) SOME MODELS FOR THE ANALYSIS OF STRESSES IN A TUBULAR FUEL PIN FOR HIGH TEMPERATURE REACTORS BY FINITE ELEMENTS. Alujevic, A.; Head, J. L.; Rodgers, I. H. (Imperial Coll. of Science and Tech., London). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

In order to study the postulated time dependent stress problem, two different finite element computer codes, a two-dimensional body of revolution BREL, and a three-dimensional TRISTAN code have been developed. The 3-D programme can only be usefully used at extreme expense of time and money, and on large computers only. It also appears, that the "isoparametric" hexahedral elements used might have to be replaced by "subparametric" ("supergeometric") elements, which possess a displacement field distribution of a higher order than the element shape. This seems to be useful for structures with thermal and similar (irradiation induced) load. The 2-D axi-symmetric code, on the other hand, has proven its high applicability for the determination of time dependent stresses in tubular fuel elements for high temperature gas-cooled reactors. Several cases of discontinuity and interaction (fuel-cladding) problems have been solved with this code. Various optional models for irradiation induced dimensional changes and creep of graphite used with the 2-D code are described. Results are included with particular reference to Wigner shrinkage strain build-up during the reactor operation. 9 references. (auth)

4467 (CONF-730942-, pp vp PAPER D 2/1) SOME APPLICATIONS OF BEAM, COLUMN, AND PLATE THEORY TO PROBLEMS OF REACTOR FUEL ELEMENT DEFORMATIONS. Anderson, R. G. (United Kingdom Atomic Energy Authority, Springfields, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The physical understanding of fuel element deformations during life is reviewed. The important features of these deformations are established using approximations leading to a simple theoretical analysis of fuel deforming in the presence of creep. This theoretical treatment is applied to the following problem areas: the change of thermal bow as the bending moments induced by lateral restraints relax due to creep; the causes of waving of the heat transfer surfaces of certain Uranium-Magnox fuel elements; the estimation of lateral deflections in lengthening fuel pins which are restrained axially; and the restraint of fast reactor subassembly bowing. It is concluded from these examples that many of the characteristics of fuel element deformations during life can be obtained using quite simple ideas and mathematical analyses. 10 references. (auth)

4468 (CONF-730942-, pp vp PAPER D 3/10) EVALUATION OF IN-REACTOR VIBRATORY AND IMPACT MOVEMENTS OF CIVIL AGR FUEL ELEMENTS. Sansom, K. A.; Jones, P. M. (United Kingdom Atomic Energy Authority, Springfields, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The development of procedures for evaluating the criteria which determine the allowable vibration of the fuel is described. A new approach in relating the internal motion of components within a complex fuel assembly to the measured vibration response of the complete assembly is presented. Interpreting the wear and fatigue data from different sources to derive criteria for allowable vibratory motion is discussed. 6 references. (auth)

4469 (CONF-730942-, pp vp PAPER D 4/1) STRUCTURAL EVALUATION OF COMPONENTS IN THE HIGH TEMPERATURE REACTOR CORE. Head, J. L. (Imperial Coll. of Science and Tech., London); Kinkead, A. N. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

Developments in power producing high temperature reactors aimed at reducing material and machining costs associated with the European concept of a core structure consisting of moderator blocks fitted with separately machined and assembled fuel pins has led to the sponsoring of relatively large block type elements in the Dragon Reactor. The outer edges of such prismatic blocks must conform to the standard geometry of the Dragon seven element cluster or pin carrier. In one of the two versions already proposed the fuel compacts are in the form of solid cylinders or cartridges which are placed directly in longitudinal holes in the moderator block their cooling being effected by helium flowing in parallel holes interspaced between the fuelled holes. This fuel element is of the form used in the American HTR. In a second version of such an element to be irradiated in the Dragon Reactor the fuel particles are integrally embedded in the graphite block by a moulding process recently developed in Germany, the cooling being effected as in the first version. In such block elements variations in the thermal loading have a significant influence in the design, and the distribution of temperature on transverse sections is evaluated at each main stage in the power history. Examples of the geometry studied in current designs are described. The developments in the stress analysis considered necessary to predict the structural behaviour of such block elements during irradiation in the Dragon Reactor are reviewed. (auth)

4470 (CONF-730942-, pp vp PAPER D 4/3) INFLUENCE OF INITIAL PARAMETERS ON THE BEHAVIOUR OF THE DYNAMIC MODULUS OF ELASTICITY OF GRAPHITIC MATRIX MATERIALS FOR HTR-FUEL ELEMENTS UNDER FAST NEUTRON IRRADIATION. Delle, W. W.; Schulze, H. A.; Schulze, R. E. (Kernforschungsanlage, Juelich, Ger.). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

In general nuclear graphite is graphitized at temperatures above 2500°C, while graphitic matrix materials because of the incorporation of nuclear fuel must be heat-treated at temperatures below 2000°C. For the investigation of the behaviour of graphitic matrix materials under fast neutron exposure, irradiations in the High Flux Reactor in Petten (The Netherlands) up to high fluences at different temperatures were carried out. The behaviour of the dynamic modulus of elasticity of these materials is described. 17 references. (auth)

4471 (CONF-730942-, pp vp PAPER D 4/5) GRAPHITE STRUCTURES BEHAVIOUR IN A HIGH TEMPERATURE REACTOR CORE. Gros, G.; Goldstein, S.; Bastien, D. (CEN de-Saclay, Gif-sur-Yvette, France). 1973. (In French).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The stresses to which graphite structures are subjected in a High Temperature Reactor core with prismatic blocks are analyzed. The finite elements computer programs developed at Commissariat a l'Energie Atomique are presented. The problem of the behaviour of the graphite structures in regard to the stresses is treated. (auth)

4472 (CONF-730942-, pp vp PAPER D 4/6) TRANSVERSE IMPACT OF GRAPHITE SLEEVED FUEL ELEMENTS: THE VIBRATORY RESPONSE AND DAMAGE CRITERION. Jones, P. M. (United Kingdom Atomic Energy Authority, Springfields, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

In a Commercial Advanced Gas Cooled Reactor charge/discharge operations on the fuel will be carried out with the reactor on power. The coolant flow is such as to cause instability of the fuel stringer during these operations and some impacting of the fuel elements against the walls of the charge path is possible. A variety of transverse impact tests are described which have been carried out on CAGR fuel elements and fuel element sleeves in an attempt to specify limiting acceptable impacts. 10 references. (auth)

4473 (CONF-730942-, pp vp PAPER D 4/9) CALCULATION OF STRESSES AND DEFORMATIONS IN GRAPHITE REACTOR COMPONENTS UNDER CONSIDERATION OF THE ANISOTROPY OF MATERIAL BEHAVIOUR. Steck, E.; Schmidt, A. (Hochtemperatur-Reaktorbau GmbH, Mannheim, Ger.). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

From the two-dimensional Finite-Element-Program SIGMA, which considers only the isotropic behaviour of materials, the Program SIGMA-ANISO was developed for the calculation of deformations and stresses in graphite reactor components under consideration of the anisotropy of thermal expansion and shrinkage under neutron irradiation. For the analysis it is assumed that the maximum differences in material behaviour occur in the plane being analyzed. The anisotropy of shrinkage is taken into account by introduction of two different shrinkage curves for the two perpendicular main directions of anisotropy in this plane. These main directions coincide with those of the anisotropy of thermal expansion, which is taken into account by two different coefficients of thermal expansion. The elasticity characteristics and creep behaviour of the material are assumed to be isotropic. This program has been applied for stress calculations on various reactor components (HTR reflector blocks and HTR fuel elements), the results of which were then compared to results obtained under the assumption of an isotropic material behaviour. 5 references. (auth)

4474 (JUL-970-RG) USE OF PLUTONIUM IN THERMAL HIGH TEMPERATURE REACTORS WITH SPHERICAL FUEL ELEMENTS INVESTIGATED FOR THE THTR. Wahl, D. J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Jun 1973. 71p. (In German). Dep. NTIS (U. S. Sales Only) $5.75.

Thesis.

Due to the delay of installing fast breeder reactors and the increase of the available light water reactors, there will be a large surplus of plutonium in the next years. The feasibility of plutonium–thorium–oxide as fuel for graphite-moderated high temperature reactors with spherical fuel elements is investigated. The effect of resonance absorption of the plutonium isotopes in the thermal energy range on the reactivity and the temperature coefficient dictates that a reactor core containing only plutonium–thorium fuel is not possible. One must have a core with two fuel element types, one of which contains plutonium and thorium, the other uranium and thorium. The number of plutonium fuel elements is restricted to about 40%. The reference core which is well below thermohydraulic and neutron physics limitations has a mean gas outlet temperature of 750°C, a thermal power of 750 MW and a mean core power density of 6 MW/m^3. Two variants of OTTO-refuelling schemes are investigated. The schemes differ in the fraction of plutonium fuel elements in the core which is 21.7% and 40%. The fuel cycle costs in both cases are as attractive as for a uranium–thorium cycle. (auth)

4475 (JUL-979-RG) TWO-DIMENSIONAL CALCULATIONS OF BURN-UP AND FLOW-BEHAVIOR IN PEBBLE-BED REACTORS WITH AN ISOLATED MESH SYSTEM FOR THE DIFFUSION CALCULATION. Gilles, P. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Jul 1973. 70p. (In German). Dep. NTIS (U. S. Sales Only) $5.50.

Thesis.

Into a two-dimensional program-cycle specially developed for pebble-bed reactors, a mesh system is introduced for the discretization of the space variable. The computer program has four tasks: the spectral calculation, the diffusion calculation, the burn-up calculation and a subroutine to simulate the flow behavior of the spherical fuel elements. The size of mesh-point-system is determined above all by the specification for the movement simulation of the spheres, and is usually very fine to get sufficient accuracy. For a comparable accuracy in the diffusion calculation, such a fine mesh-point-distribution is not necessary. Furthermore, as the diffusion calculation determines mainly the calculation effort and as the calculation time increases exponentially with the number of mesh points, it is ineffective to use a fine structure mesh system. A second coarse mesh system is introduced for the diffusion-calculation and for the spectral calculation. It is coupled by neutron flux interpolation to the fine mesh system for the flow-behavior and the burn-up calculation. Comparative calculations were not only performed for a homogeneous but also for a heterogeneous refuelled pebble-bed core. By choosing a suitable coarse mesh system the calculation time decreased strongly, whereas the deviations in the results were only small. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstract 4499.

4476 (CONF-730324-, pp 15-17) SIMULATION OF WIRE ACTIVATION EXPERIMENTS IN UNIT 2 OF PICKERING. Attia, E. A. 1973.

From ANS Niagara–Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

4477 (CONF-730324-, pp 47-52) CALIBRATION OF THE DFP TRAPS ON THE PICKERING FAILED FUEL DETECTION AND LOCATION SYSTEM. Molson, L. D. 1973.

From ANS Niagara–Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

4478 (CONF-730942-, pp vp PAPER D 1/6) BOWING OF PELLETIZED FUEL ELEMENTS: THEORY AND IN-REACTOR EXPERIMENTS. Veeder, J. (Chalk River Nuclear Labs., Ont.); Schankula, M. H. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

Fuel element bowing is defined as the lateral deflection of an element during irradiation. The phenomenon of bowing in pelletized fuel elements is analyzed with special reference to observations and experiments made in WR-1, an organic-cooled, heavy-water moderated research reactor located at Pinawa, Manitoba. The elements are constituents of fuel bundles similar in size and shape to those used in CANDU (CANada Deuterium Uranium) power reactors. 7 references. (auth)

4479 (CONF-730942-, pp vp PAPER D 3/7) IN-REACTOR VIBRATION BEHAVIOUR OF NUCLEAR FUEL. Pettigrew, M. J.; Turner, R. B. (Chalk River Nuclear Labs., Ont.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

Vibration and fretting endurance studies of nuclear fuels for CANDU reactors are usually conducted in out of reactor adiabatic test facilities. Under actual reactor conditions, the mechanical characteristics of the fuel are affected by thermal expansion of, in particular, the UO_2 fuel pellets. Also, under diabatic conditions, additional flow-induced vibration excitation sources are possible such as nucleate boiling noise at the surface of the fuel elements and enhanced cross-flow between fuel bundle subchannels due to possible enthalpy imbalance. The results of an experiment to study the in-reactor vibration behavior of nuclear fuel are presented. The experiment was conducted in the NRU reactor in a two-phase flow test loop simulating a 10.4 cm ID CANDU-BLW fuel channel. Five 50 cm long fuel bundles each consisting of eighteen 2 cm OD fuel elements assembled by means of a central supporting tube were used in the experiment. Results are presented. (auth)

4480 (CONF-730942-, pp vp PAPER D 3/8) RESPONSE OF A REACTOR FUEL STRING TO FLOW AND STRUCTURALLY TRANSMITTED EXCITATION. Forrest, C. F.; Hancox, W. T. (Westinghouse Canada Ltd., Hamilton, Ont.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

In a pressure tube reactor, relative motion between the fuel string and the flow tube may cause damage to individual bundles in the string and to the flow tube walls. Two possible sources of this motion are, the inherent turbulence in the flow, and motion of the support structure caused by external sources and transmitted to the flow tube and the string via its piping connections and structural supports. An experimental study of the latter is described. The experimental apparatus consisted of a vertical flow tube containing a handing string of six 0.5 m long UO_2 CANDU fuel bundles which were loaded end to end on a central support tube. The test section was isolated from external excitation sources by flexible connectors. Excitation was imposed by water upflow (average velocities ≤ 14 m/sec) and band limited random vibrations (0 to 80 Hz, constant acceleration) introduced by an excitor attached to the lower end of the flow tube. Motion of the flow tube (x) and relative motion between the string and flow tube (y) were monitored with velocity transducers. 6 references. (auth)

4481 (CONF-730942-, pp vp Paper D 4/8) STRENGTH TESTS ON SPHERICAL FUEL ELEMENTS. Schmidt, A.; Kleine Tebbe, A.; Kurth, H.; Theymann, W. (Hochtemperatur-Reaktorbau GmbH, Mannheim, Ger.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The fuel elements of the pebble bed reactor are exposed to different mechanical stresses during their operating life. On the one hand, due to the reactor core-flow, they are repeatedly dropped to the pebble bed from heights of up to 4 m, on the other hand, they can be hit by a dropping fuel element or by a shut-down rod being inserted into the pebble bed. In addition, it must be considered that the individual fuel elements, exposed to stresses in the reactor, may have different stress histories. A fuel element may e.g. be hit by a shut-down rod after having been exposed to several impacts by falling spheres or it may be exposed to further drop and impact stresses after several impacts have been exerted by a shut-down rod. In order to obtain a statement on sphere rupture in the reactor, the impact resistance-defined as the number of drops until rupture- and the crushing resistance of the fuel elements must be known under the given conditions. Test procedures to determine the impact strength are described. (4 references) (auth)

4482 (CONF-730942-, pp vp Paper D 4/10) ABRASION LOAD ON THE REFLECTOR OF A PEBBLE BED REACTOR. Elter, C. (Technische Ueberwachungs-Verein Baden, Mannheim, Ger.); Matentzoglu, N. 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The pebble filling of a pebble bed reactor is pressed on the reflector by the following: its dead-weight; pressure differences of the cooling gas in the core; and the additional larger pressures resulting from bringing the core control rods into the pebble bed. During the exchange of pebbles in the reactor core the pebbles slide with force acting against the reflector over the planes and joints of the graphite blocks, over the edges of the disorder trays, and over the cooling gas holes of the core bottom blocks. The varying forces by which the pebbles are pressed on the reflector cause a local stress due to the contact pressure and to the shearing by movement of the pebble bed during the exchange of pebbles. Moreover, the edges of the reflector blocks are loaded by shearing. Based on theoretical considerations the geometric relations are presented. They are used to design the reflector surface by which the load at the reflector planes and edges is within the allowable range. (auth)

4483 TECHNOLOGICAL EQUIPMENT OF THE A-1 REACTOR (KS-150). Stepanek, S.; Zbytovsky, A. Jad. Energ.; 19: No. 9, 307-311(1973). (In Czech).

The A-1 nuclear power reactor and its fundamental elements are described. A brief description of the reactor safety and control system and some peculiarities in modifications of the technological channel and charging machine in the time of bringing the First Czechoslovak Nuclear Power Plant into operation are presented. (auth)

4484 RADIATION PROTECTION IN NUCLEAR POWER PLANT BOHUNICE DURING START OF OPERATION. Carach, J. (Krajska Hygienicka Stanica, Bratislava); Petrasova, M.; Viktory, D.; Chorvat, D.; Kollar, J.; Minarik, F.; Trnovec, T.; Feik, K.; Konecny, J.; Parimucha, F. Jad. Energ.; No. 9, 321-323(1973). (In Czech).

Reported are radiation protection aspects of operation of nuclear power plant Bohunice. Measures adopted for protection of personnel during physical and energetic start-up of the atomic station are described. The gamma and neutron radiation fields in various areas of the plant are evaluated and surveys of personal doses, radioactive contamination of the cooling gas and moderator D_2O are given. Data about liquid, gaseous effluents and principles of environmental monitoring are reported. (auth)

4485 FUEL ELEMENTS FOR THE REACTOR KS-150. Spetko, V. Jad. Energ.; 19: No. 9, 312-318(1973). (In Czech).

Selected work connected with the securing of the fuel elements for the first Czechoslovak nuclear power plant reactor, KS-150, is described. There are given the first results of fuel elements operation within the reactor and the first stage of the nuclear power plant commissioning. (auth)

4486 START-UP OF A-1 NUCLEAR POWER PLANT. Keher, J. Jad. Energ.; 19: No. 9, 297-302(1973). (In Czech).

The most important aspects of the Nuclear Power Plant A-1 start-up are presented. Detailed descriptions are given of the following parts: Preparations for the start-up–a great stress is laid on the evaluation of complex tests and operational personnel preparations. The list of documentation which was necessary for the start-up initiation is also attached. A part dealing with the start-up describes the start-up program and the results, which have been achieved. The results are tabulated. The most important steps which were necessary to carry out in increasing the reactor power. (auth)

4487 NECESSITY OF NUCLEAR DATA FOR THE DETERMINATION OF THE OPERATING PERIOD OF HEAVY-WATER REACTORS WITH NATURAL URANIUM. Blagovolin, P. P. (Inst. of Theoretical and Experimental Physics, Moscow). pp 14-18 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The calculation errors in the operating period of a heavy-water reactor with uranium of natural enrichment are analyzed. The errors are connected with inaccuracy of the constants involved in the calculation. (auth)

Power Reactors, Breeding

Refer also to abstracts 2994, 3052, 3053, 3681, 4452, 4518, and 4526.

4488 (CONF-730942-, pp vp Paper C 2/4) RESULTS OF ANALYSES OF LMFBR FUEL ROD CLADDING TO PREDICT FAILURE UNDER PROTOTYPIC LOADING CONDITIONS. Sim, R. G.; Vaidyanathan, S. (General Electric Co., Sunnyvale, CA). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The failure mechanisms for mixed oxide fuel rods in a fast flux/flowing sodium environment are ill-defined. There are many loading mechanisms which might contribute to the failure of a rod. Out of these loading mechanisms the fuel to clad interaction problem has received the most attention with the others being almost totally neglected. The results reported are part of a program of analyses directed towards evaluating the relative importance of these other clad loading mechanisms for typical reactor operating histories. The loading mechanisms considered include the internal fission gas pressure, the wastage of the clad wall thickness, the contact loads due to spacer restraint and the thermal and differential swelling stresses which result from considering prototypic temperature distributions. Analyses have been conducted using a variety of tools. The fission gas, the wall thinning and the temperature effects were analyzed using a two-dimensional generalized plane strain code called GOGO. The GOGO code solves the problem on a closed form basis except for some terms which are evaluated by numerical integration. The contact load problem was analyzed using the CREEP-PLAST (two-dimensional plane strain model) and the MARC-CDC (three-dimensional model) finite element codes. (4 references) (auth)

4489 (CONF-730942-, pp vp Paper C 3/1) TRANSIENT FUEL-CLADDING DEFORMATION ANALYSIS OF THE IN-PILE H3 "TREAT" TEST WITH THE "SAS2A/DEFORM-II" CODE. Royl, P.; Watanabe, A.; Agrawal, A. (Argonne National Lab., IL). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

A new model for the transient fuel-pin deformation analysis has been developed for oxide-fueled fast breeder reactors. The model, designated as DEFROM-II, is a module of the SAS2A fast-reactor accident analysis code and is currently used for calculations of fuel behavior in unprotected overpower transients in FFTF and in support of the TREAT program at Argonne National Laboratory. The new SAS2A/DEFORM-II code system has been used to analyze the transient fuel-cladding deformation for the H3 in-pile TREAT test, during which a pre-irradiated fuel pin was subjected to an overpower transient corresponding to a 0.5-1$/sec power ramp in FFTF. The EBR-II-irradiated pin was surrounded by a hexagonal array of six fresh FTR type pins in flowing sodium and placed in a Mark-II loop. Of particular importance for the transient deformation results were the gap size and fuel porosity. The measured transient power variations and coolant-inlet conditions from the experiment were used for the deformation analysis by the SAS2A/DEFORM-II code system. (17 references) (auth)

4490 (CONF-730942-, pp vp Paper C 3/3) FINITE ELEMENT STRESS ANALYSIS OF INTERACTING FUEL PELLET AND CANNING UNDER FAST REACTOR CONDITION. Keegstra, P. N. R.; Head, J. L.; Alujevic, A. (Imperial Coll. of Science and Tech., London). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The design of fuel elements for sodium cooled fast reactors implies the analysis of stresses, strains, displacements and interacting forces in both UO_2 pellet and metal canning. The use of a two-dimensional finite element method is proposed. A program has been developed which assumes axial symmetry of geometry and loading (i.e., axi-symmetric temperature and flux distribution in a body of revolution), but discards the plane strain restriction. A standard finite element program (using triangular elements) has been modified to allow for time dependent phenomena, including complete power cycles from start-up to full operation and shutdown. The interaction effects between fuel pellets and canning are studied by an unorthodox finite element technique, where the nodes of the structures on the interface between the two parts do not match. This approach thus allows for the possibility of frictional relative movement of the two structures. An important part of the computation described is the analysis of the temperature distribution in a hollow compounded cylindrical body of the fuel element. The stress distributions in the canning are included in the form of contours of isobars for various stages of interaction with particular reference to different axial friction coefficients. (12 references) (auth)

4491 (CONF-730942-, pp vp Paper D 1/4) UTILIZATION OF THE "PIPER" PROGRAM FOR MECHANICAL AND THERMAL ANALYSIS OF FAST REACTOR MIXED OXIDE FUEL PINS. Firstenberg, H. (NUS Corp., Rockville, MD); Tripp, L. E.; Kikuchi, S.; Yokouchi, Y. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The PIPER code was developed for the analysis and prediction of fuel pin performance during irradiation in a fast reactor environment. The code is designed to model the integrated thermal, stress and deformation behavior of oxide fueled, stainless steel clad fuel pins at several axially distributed points along its length as a function of a prescribed operating history of linear power rate, coolant inlet temperature, coolant flow rate, and fast fluence. Axial variations in the linear power and fast flux as well as fuel density and composition are accommodated by the ability to divide the fuel region into as many as ten arbitrary axial modes. Although PIPER is intended primarily as a design tool, the input and models are sufficiently flexible to permit the analysis of encapsulated pins for interpretation of and guidance to experimental irradiations. (auth)

4492 (CONF-730942-, pp vp Paper D 2/4) CONTRIBUTION TO THE LMFBR FUEL PIN BEHAVIOR DURING TRANSIENT OVERPOWER CONDITIONS. Kuczera, B. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The long-time behavior of the fuel pins under steady state reactor conditions has been studied extensively. However, with respect to the safety analysis there exists a particular interest in the short-time behavior of a LMFBR fuel pin during an overpower transient, and its state at the time of cladding failure. The study presented deals with the behavior of unirradiated fuel pins during a power excursion (reactor period = 17 msec). The pin type A(X_{max}= 420 W/cm, gap size Δs = 0.07 mm, fuel porosity P_0 = 0.07) will be used as a reference pin; it is similar to the fuel pin of the SNR-300. The pin type B has a smaller gap size (Δs = 0.05 mm), whereas pin type C has a larger porosity (P_0 = 0.12). The numerical analysis was performed with the computer code BREDA. The investigation of the influence of fuel rod design parameters on the short-time behavior of fuel pins during the pre-disassembly phase of a hypothetical accident is presented. (9 references) (auth)

4493 (CONF-730942-, pp vp Paper D 2/5) FAST-REACTOR FUEL-ELEMENT ANALYSIS USING MULTIREGION FORMULATION IN "LIFE-II". Jankus, V. Z. (Argonne National Lab., IL). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The LIFE-II code used various materials behavior models (each confined to an appropriate subroutine) to describe the behavior of the entire fuel element during its life in a reactor subject to numerous power and coolant temperature variations. The thermal and mechanical calculations are performed by subdividing the fuel element into several long, loosely coupled axial sections. In each axial section, one-dimensional thermal integration is made, and mechanical analysis is done by an axisymmetric generalized-plane-strain formulation. In previous calculations, three radial regions had been used for the fuel and one for the cladding. These three structural regions were assumed to coincide with the three structural regions observed in irradiated fuel, i.e., columnar grain, the equiaxed grain, and the unrestructured regions. (auth)

4494 (CONF-730942-, pp vp Paper D 2/6) FAILURE CRITERION FOR SUBASSEMBLY FUEL ELEMENTS SUBJECTED TO A PRESSURE PULSE LOADING. Hibbeler, R. C.; Wang, P. Y. (Argonne National Lab., IL). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The potential for fuel element failure propagation is of concern for both the operation and safety of nuclear reactors. A sudden failure of one fuel element may potentially lead to a cascading failure of adjacent elements, which may ultimately threaten the integrity of the subassembly. The nature of this failure may be a sudden clad breach caused by internal pressure, and consequently, a shock wave may be formed. In assessing the damage which may be caused by the shock wave, it is assumed that the fuel element fails near the plenum region, since the combination of temperature and radiation effects within this region are severe. Furthermore, the dynamic effects are anticipated to be more severe in this region since fission gas escape is more rapid following rupture, and the adjacent fuel elements have low inertia characteristics. Essentially, the problem is formulated on the basis of establishing a failure criterion for a thin cylindrical shell sustaining an internal pressure and subjected to a side-on blast load. Parameters used in this study are typical for fuel elements used in current LMFBR designs. (9 references) (auth)

4495 (CONF-730942-, pp vp Paper D 2/7) STRUCTURAL ANALYSIS OF THE BEHAVIOUR OF A HEXAGONAL WRAPPER TUBE IN A FAST REACTOR ENVIRONMENT. Guyette, M.; Capart, G. (Belgonucleaire, Brussels). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

A computer program called STRAW has been developed in order to assess the stress and strain distributions in hexagonal wrapper tubes and their evolution with the time when irradiated under fast reactor conditions. This computer program, which handles in their three-dimensional form the swelling and creep phenomena, considers three main causes of stressing in the tube: compatibility stresses arising from the non-uniform thermal, swelling and creep strain fields; pressure difference between the inside and the outside of the tube and the coolant drag forces; and restraints to the free bowing of the tube imposed by the core clamping system. The external constraints acting on the tube (neutron flux, temperature distribution, pressure drop and effects of the clamping system) are all taken into account three-dimensionally and with their time dependence. (auth)

4496 (CONF-730942-, pp vp Paper D 2/8) FORCES AND DEFLECTIONS AT LMFBR FUEL ELEMENT BOXES DUE TO THERMAL, SWELLING, AND CREEP STRAINS. Liebe, R. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

High temperatures and neutron flux densities cause a severe change of the mechanical behavior of steel. Core temperature and flux profiles produce significant radial transverse gradients across subassembly cross sections. Corresponding thermal and swelling strain differences give rise to bowing of each subassembly box. Since all boxes are multiply supported (core clamping areas), bowing is associated with bending stresses and restraint forces. In turn these stresses are relaxed by thermal as well as irradiation induced creep of the material. Therefore linear methods are not sufficient to analyze safe and economic fast breeder cores. Description and application are given of a new method to analyze the time dependent stresses, forces and deflections at a single subassembly box due to the interaction of thermal, swelling and creep strains. (7 references) (auth)

4497 (CONF-730942-, pp vp Paper D 3/1) RESPONSE PREDICTIONS FOR RESONANT AND RANDOM VIBRATIONS OF FAST REACTOR FUEL SUB-ASSEMBLIES. Jobson, D. A. (United Kingdom Atomic Energy Authority, Risley, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The sub-assemblies of a fast reactor core are subject to small disturbances, particularly as a result of any unsteadiness in the coolant out-flow. Fluctuations of reactivity may thus result from the associated lateral fuel movements induced at core level. These movements are likely to be complex in character and sensitive to any factors which affect the flow conditions at exit. Response to the latter will depend on the disposition of the fuel and other components, within each subassembly, as well as on the flexibility of the wrapper and the manner of its support. A simple analytical model is proposed to explore the interactions between the above factors, so enabling comparative predictions to be made between alternative designs. It is based on a consideration of the point of application and likely nature of the excitation. This suggests that only the fundamental mode of the sub-assembly will normally be significantly excited in the above way. Having determined the frequency and modal shape of the latter, its excitation is defined through the use of a Newtonian force coefficient in terms of the dominant flow parameters at exit. Using the diameter of the latter as a normalising dimension, a Stroubal number is introduced, on the undamped natural frequency, the diameter at exit and the associated mean flow velocity. The root mean square (r.m.s.) of the resonant response is thus obtained and defined in terms of the Strouhal number, for a given sub-assembly and coolant density. (auth)

4498 (CONF-730942-, pp vp Paper D 3/6) RANDOM PRESSURE INDUCED VIBRATION OF PIN ENDED CYLINDRICAL RODS. Thompson, J. J.; Holy, Z. J. (Univ. of New South Wales, Kensington, Australia). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The exact normal mode elasticity theory solution is developed, for a pin ended cylindrical rod or tube with arbitrary time dependent random surface pressure fluctuations. Potential flow theory and damping coefficients are used to allow for the pressure of the infinite fluid in which the system vibrates. The equations are applied to the case of a stationary and spatially homogeneous random pressure field, and formulae are developed for the variances of the radial and tangential displacements and differential surface axial strain, as functions of position, in terms of the spectral density of the local pressures, and the Fourier components of the normalized circumferential and axial cross spectral densities. Numerical studies explore the effect of pressure field and structural parameters in comparison with the Bernoulli-Euler model of the same problem. (4 references) (auth)

4499 ROLE OF HTGRs AND FBRs IN MEETING THE ENERGY CRISIS. Fortescue, P.; Stewart, H. B. (Gulf General Atomic Co., San Diego, CA). Mech. Eng.; 95: No. 11, 14-17 (Nov 1973).

The joint role of FBR's and HTGR's may offer the most promising way of meeting the impending energy crisis. The fast breeder reactor uses a U cycle to refuel itself. Its excess-bred fuel can be exploited in a high-temperature gas-cooled reactor, a thorium-cycle-based converter type. For this purpose, a fissile feed material such as 233U can be bred in thorium blankets around FBR cores. Both reactor types can be used to complement each other. The nominal performance attractions of the HTGR type of reactor power plant are reinforced by the many practical operational and maintenance advantages that inert gas cooling provides. Consideration of the future potential of the gas turbine additionally affords the greatest promise of substantial plant cost reduction thus far advanced. The combination of this prospect and the fuel resource conservation feature hitherto associated solely with the introduction of the breeder alone can be fully realized only by appropriate deployment of both types of systems. This is a fortunate circumstance in the effort to successfully meet the long-range energy crisis. (MCW)

4500 NECESSITY OF NUCLEAR DATA FOR CALCULATION OF FAST REACTORS. Zaritskii, S. M.; Nikolaev, M. N.; Troyanov, M. F. (Moscow Engineering-Physics Inst.). pp 5-14 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

With the needed accuracy of calculations of doubling time (±10%), k_{eff} (±1%), and breeding ratio (±2%) for large plutonium breeders as a starting point, requirements were formulated for the accuracy of such evaluated nuclear data as σ_f for ^{235}U, ν_f for ^{252}Cf, α for ^{239}Pu, cross section ratios $\sigma_c^{i}/\sigma_f^{235}$, $\sigma_c^{i}/\sigma_f^{235}$, cross sections of inelastic moderation, etc. The multigroup constants for reactor calculations are produced from these nuclear data. (auth)

Research, Test, and Experimental Reactors

Refer also to abstracts 2679, 2801, 3028, 3682, 4489, and 4527.

4501 (CONF-730324-, pp 3-8) RADIOACTIVE ISOTOPES IN REACTOR POOL WATER. Ulinski, J. A. (SUNY Coll., Brockport, N. Y.). 1973.

From ANS Niagara–Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

4502 (CONF-730942-, pp vp Paper C 2/6) INTERNAL PRESSURE FATIGUE RUPTURE TEST ON FUEL CLADDING FOR FAST REACTOR. Maki, H.; Kusumoto, S.; Hara, T.; Uematsu, K. (Hitachi Ltd., Ibaraki, Japan). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The result is presented of the internal pressure fatigue rupture test that was conducted at high temperatures on fuel cladding for the fast experimental reactor "JOYO." The purpose of this test is to clarify the internal pressure fatigue characteristics of the fuel cladding, thereby obtaining the allowable stress of the fuel cladding so that it may be used in the fuel design. The fuel cladding was made of Type AISI 316 stainless steel and its dimensions were 5.60 mm I.D. and 0.35 mm wall thickness. The test apparatus was developed to give internal pressures cycles into tubular specimens under constant high temperature or coinciding with temperature cycles fully automatically. The fatigue rupture test was conducted on tubing section and end. (auth)

4503 (HEDL-TME-73-70) CHARACTERIZATION OF PROTOTYPIC FTR FUEL DUCT TUBES (RM-35). Paxton, M. M.; Aungst, R. C.; Epperson, E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1973. Contract AT(45-1)-2170. 44p. Dep. NTIS $5.45.

A three year fuel duct development and vendor qualification program has been completed. A characterization of prototypic 20% cold-worked 316 Stainless Steel fuel duct tubes manufactured by two qualified vendors is presented. Dimensional data on all the duct tubes from each vendor are presented. Dimensional stability was ascertained by performing a series of stress relief anneals at 1165°F. The metallurgical condition was determined from hardness profiles and optical metallography, and mechanical properties were determined from tensile and creep-rupture tests. (auth)

4504 (JUL-975-RG) CRITICAL HTR-EXPERIMENT CESAR-2: AN EXPERIMENTAL TEST ON THE VALIDITY OF NEUTRON PHYSICAL CALCULATIONS FOR HIGH-TEMPERATURE REACTOR DESIGN. Scherer, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Jul 1973. 120p. (In German). Dep. NTIS (U. S. Sales Only) $10.50.

Thesis.

The critical HTR-experiment CESAR-2 was performed in cooperation between the KFA-Jülich GmbH and the French atomic energy authority CEA in order to test numerical predictions of the neutron-physical behavior of high-temperature reactors. The experiment, the methods used, computer-codes for the neutron-physical calculations, and a detailed comparison of measured and calculated values are presented. According to the observed differences between theory and experiment which can be essentially referred to problems in calculation of resonance absorption for strong heterogeneous fuel elements, the limits for a suitable application of the examined computer codes are described. (auth)

4505 (JUL-981-RG) THERMIONIC CORE-CONFIGURATIONS OF THE CRITICAL ASSEMBLY ITR. Bloser, M.; Kirch, N.; Krings, F. J.; Paul, N.; Naseband, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Jul 1973. 52p. (In German). Dep. NTIS (U. S. Sales Only) $4.75.

The physical properties of the ITR such as compactness, heterogeneity, and the new specific materials for the thermionic-zone required a critical experiment for checking the design calculations. The thermionic configurations and the mockup of the ITR are described. The experimental results are compared with actual available calculations of other authors. The results show that there are differences between experiment and calculation of kinetic parameters of small configurations, of reactivity values containing Wolfram components, and of power flattening. Monte Carlo methods and measuring techniques developed were successfully tested for reactivity disturbances introduced by the reflector even for complicated geometries. (auth)

4506 EXTRACTION OF ULTRACOLD NEUTRONS FROM REACTORS. Golikov, V. V.; Lushchikov, V. I.; Shapiro, F. L. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 112-119 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev.; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

Calculations of the yield of ultracold neutrons from different converters according to the temperature of the converter and the initial neutron spectrum are presented. The results of the calculations are compared with the experiments performed at the IBR-30 pulsed reactor. The channel for the ultracold neutron investigations at the IBR-30 reactor is described. (3 figures, 3 tables) (auth)

4507 USE OF LIQUID HYDROGEN AS A SOURCE FOR COLD NEUTRONS. Antonov, A. V.; Wo Tak Pang; Isakov, A. I.; Merkul'ev, Yu. A. (Lebedev Inst. of Physics, Moscow). pp 119-123 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

The interaction between slow neutrons and liquid hydrogen was investigated. The experimental results are discussed. The parameters which may be used in the construction of reactors and cold neutron sources with liquid hydrogen as moderator are given. (2 figures) (auth)

4508 PULSED REACTORS IBR-30 AND IBR-2 WITH INJECTORS AS SOURCES FOR NEUTRON SPECTROSCOPY IN THE RESONANCE ENERGY RANGE. Yazvitskii, Yu. S. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 209-215 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

Some characteristics of the IBR-30 and IBR-2 pulsed reactors of the Joint Institute for Nuclear Research are presented. The IBR-30 reactor was put into operation in 1969, and its mean power is 25 kW. The construction of the IBR-2 reactor was begun in 1969. Its design mean power is 4 MW. The IBR-30 and IBR-2 reactors have injectors (linear electron accelerators) and can work in the booster regime. (3 figures, 1 table) (auth)

4509 PULSED NEUTRON BEAM FORMED IN THE SM-2 REACTOR BY A CHOPPER WITH SYNCHRONOUSLY ROTATING ROTORS SUSPENDED IN A MAGNETIC FIELD. Kalebin, S. M. (Inst. of Theoretical and Experimental Physics, Moscow); Rukolaine, G. V.; Artamonov, V. S.; Nikol'skii, S. N.; Pelevin, G. A.; Kocherygin, N. G.; Belanova, T. S.; Babich, S. I. pp 267-275 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

Neutron time-of-flight equipment of the SM-2 reactor is described. The intensity of the pulsing beam and the background conditions were investigated. The problems of resolution increasing up to 3ns/m and cross section of the beam decreasing up to 1 mm^2 are discussed. (4 figures) (auth)

Propulsion and Package Reactors

Refer also to abstracts 3001, 3002, 3097, and 4517.

4510 (ANL-6522) STATUS REPORT I ON THE TESTING GRAPHITE-TYPE NUCLEAR ROCKET (ROVER) FUEL IN A PULSED REACTOR (TREAT). Liimatainen, R. C.; Ivins, R. O.; Vogel, M. A.; Testa, F. J. (Argonne National Lab., Ill. (USA)). Apr 1962. Contract W-31-109-eng-38. 18p. Dep. NTIS $3.00.

Declassified 2 Aug 1973.

Six experimental Rover fuel assemblies containing an enriched-uranium-bearing graphite fuel were irradiated in the TREAT reactor to various power levels in order to determine temperature and power thresholds for the destruction of the fuel specimens. (JWR)

4511 (ANL-6774) NUCLEAR ROCKET STUDY EVALUATION REPORT. Marchaterre, J. F.; Almenas, K. K.; Golden, G. H.; Hoglund, B. M.; Kolba, V. M.; Loewenstein, W. (Argonne National Lab., Ill. (USA)). Sep 1963. Contract W-31-109-eng-38. 144p. Dep. NTIS $9.25.

Declassified 2 Aug 1973.

Concepts of reactors that could serve as alternatives to the fueled graphite family of KIWI reactors have been studied. To be a true alternative, i. e., have a different set of development problems, such reactors should use fuel other than that used in the KIWI reactors. The classes of fuel considered were narrowed to two, namely, mixed carbides and tungsten-base cermets. Further, immediate consideration of the mixed carbides was then rejected on grounds discussed. The tungsten-base cermets can be used in either fast or heterogeneous moderated reactor systems, depending upon the degree of ^{184}W enrichment, the volume fraction of fissile refractory in the cermet, and the arrangement of fuel and (if necessary) moderator in the core. Consideration of design problems favors water as a moderating material. Thus, there are three reactor concepts that show promise as alternatives to the KIWI reactors. These are the $W-UO_2$ fast, $W-UO_2$ water-moderated, and $^{184}W-UO_2$ water-moderated systems. Of these, the fast reactor system is considered to be the best choice. (auth)

4512 (JPRS-60179) CONTROL IN SPACE. (Joint Publications Research Service, Washington, D. C. (USA)). 2 Oct 1973. Translated from Upravleniye v kosmose, Vols. 1, 2. 39p. Dep. NTIS.

Papers are presented on the orientation system of the Molniya-1 satellite, automated monitoring of the reliability of onboard computers, and the synthesis of optimal control systems for nuclear power reactors aboard spacecraft. (JWR)

4513 (WANL-TME-542) RELEASE OF FISSION PRODUCTS FROM UC_2–GRAPHITE FUELS. Rymer, G. T.; Henninger, W. A.; Grandy, G. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Aug 1963. 39p. Dep. NTIS $4.00.

Declassified 29 Aug 1973.

Data on the release of fission products from UC_2-graphite fuels used in KIWI and NERVA reactors are presented. (JWR)

4514 (WANL-TME-1091) IMPROVED NUCLEAR STANDARD DESIGN METHOD FOR NERVA CALCULATIONS: NSDM-II. Ravets, J. M.; Kopp, L. I.; Mowery, A. L.; Sipush, P. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1965. 236p. Dep. NTIS $14.00.

Declassified 30 Aug 1973.

The development of an improved Nuclear Standard Design Method, NSDM-II, to be used at WANL for the nuclear design of the NRX and future reactors is described. The NSDM-II procedure contains a number of significant theoretical and practical advantages over the NSDM-I procedure used for the NRX-A2 design. These advantages include the use of more accurate microscopic cross section libraries with proper spectral weighting to obtain few group constants. Power distribution calculations with the CURE two-dimensional diffusion theory code will now employ a simplified (r, Θ) geometrical layout requiring less than 50 percent of the NSDM-I mesh needed for similar calculations. Improved multi-fast and multi-thermal group neutron energy representation is an additional feature. The capability of using detailed (explicit) geometrical representation in final (r, Θ) CURE calculations was also developed. The procedure is already highly mechanized and is amenable to further automation. Included in the report are comparisons of NSDM-I and NSDM-II calculations with the PAX experiments; these comparisons indicate the better reliability of the NSDM-II. Although NSDM-II is intended primarily for use in the nuclear calculations associated with the NRX reactors, several of its features are directly applicable to other reactors. (auth)

4515 (WANL-TME-1165) INTERIM REPORT ON FISSION PRODUCT RELEASE FROM NERVA FUEL DURING POST IRRADIATION THERMAL ANNEALS AND DURING THE NRX-A2 TEST. Rymer, G. T.; Grandy, G. L.; Henninger, W. A.; Roll, J. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1965. 59p. Dep. NTIS $5.00.

Declassified 30 Aug 1973.

Research progress is reported on thermal anneal experiments on N6C Type II NERVA fuel, post irradiation radiochemical analyses of NRX–A2 samples, and comparisons of fission product release in NRX–A2 as predicted by FIPDIF-code calculations with radiochemical determinations. (JWR)

Reactor Safety and Environmental Aspects

Refer also to abstracts 2628, 2634, and 2647.

4516 (AEC-tr-7480) BROOKHAVEN REPORT (WASH-740): CONTENTS AND SIGNIFICANCE. Merton, A. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs Vereine e. V., Cologne (F. R. Germany)). 1973. Translation of IRS-S-9. 11p. Dep. NTIS $3.00.

The origin, content, and significance of the 1957 Brookhaven report (WASH-740) on the consequences of power reactor accidents are analyzed. The changes and improvements which have made the report obsolete are discussed. (JWR)

4517 (AI-AEC-13100) AEROSPACE SAFETY PROGRAM: SUMMARY REPORT. Otter, J. M.; Buttrey, K. E.; Johnson, R. P. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jul 1973. Contract AT(04-3)-701. 353p. Dep. NTIS $10.60.

Projects in support of the Aerospace Nuclear Safety Program are summarized. The objective of the program was to evaluate the radiological safety of SNAP systems and to develop methods and designs to assure that safety. Projects summarized are analyses and experiments for determining: (1) the disintegration of reactors reentering the atmosphere; (2) the burnup of fuel elements reentering the atmosphere, including ablation and dispersal of particles; (3) reactor criticality conditions and the assurance of subcriticality in water; (4) the behavior of reactors in transient power operation; (5) the nuclear behavior of reactors on impact with the earth and in handling accidents; (6) the assurance of shutdown at the end of the power production lifetime; (7) risks by various exposure modes from different methods of reactor disposal; and (8) thermophysical properties of SNAP fuel materials. (auth)

4518 (ANL-8037) HEAT-TRANSFER PROBLEMS IN LMFBR CONTAINMENT ANALYSES. Marciniak, T. J. (Argonne National Lab., Ill. (USA)). Jul 1973. Contract W-31-109-eng-38. 45p. Dep. NTIS $4.00.

Consideration is given to the role of heat transfer in the evaluation of the consequences of a postburst accident. The problem cannot be treated generally, due to the complexity of the phenomena involved and the dependence of heat-transfer models on the state of the reactor at the termination of the nuclear burst. Several cases encountered in present hypothetical core-disruptive accident (HCDA) analyses are discussed, along with a description of two separate heat-transfer models that have been added to the REXCO-H containment code. The models are concerned with conduction heat transfer between zones and with a model of fuel-coolant interaction which acts as a pressure-source term. Each model is demonstrated with appropriate examples, and preliminary results are presented. (auth)

4519 (BMFT-FBK-73-1) NUCLEAR SAFETY OF SITE INDEPENDENT POWER PLANTS AND THE INFLUENCE OF SAFETY ON ECONOMY. Fuerste, W.; Hemmerling, H.; Koenig, W.; Pfeiffer, A.; Rossberg, K. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany)). Feb 1973. 153p. (In German). Dep. NTIS (U. S. Sales Only) $9.75.

The economic exploitation of nuclear energy involves various safety problems. These problems are fundamental, because the effects of radiation on human life are fragmentarily known. Therefore a systematic determination of safety measures for the construction and operation of nuclear power plants is difficult to obtain. Today's safety measures and minimal safety costs are analyzed. This study is a basis for further safety–economics studies on nuclear power plants, especially in comparison to other well known energy sources. (auth)

4520 (CENPD-67) IODINE DECONTAMINATION FACTORS DURING PWR STEAM GENERATION AND STEAM VENTING. Martucci, J. A. (Combustion Engineering, Inc., Windsor, Conn. (USA). Nuclear Power Dept.). Sep 1973. 69p.

The emissions of radioactive iodine in saturated steam from a PWR vertical U-tube steam generator during normal and fault chemistry conditions are examined. It is concluded that mechanical entrainment is the controlling iodine transport mechanism in the steam phase. Operating experience and laboratory experiments substantiated that volatile forms of iodine do not occur in the steam generator. This conclusion supports C–E's position on iodine decontamination factors in C–E designed and fabricated steam generating equipment. As a direct result of this work, steam generator iodine decontamination factors should not be lower than a value of 400 for design basis studies or greater than 1000 for normal operation studies. (auth)

4521 (CONF-730324-, pp 11-14) NUCLEAR REACTORS AND THERMAL POLLUTION. Thibault, J. J. (Royal Military Coll. of Canada, Kingston, Ont.). 1973.

From ANS Niagara–Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

4522 (DOCKET-50305-119) KEWAUNEE NUCLEAR POWER PLANT PREOPERATIONAL THERMAL MONITORING PROGRAM OF LAKE MICHIGAN, SECOND ANNUAL REPORT, JANUARY–DECEMBER 1972. (Wisconsin Public Service Corp., Green Bay (USA)). 24 Oct 1973. 574p. Dep. NTIS $30.75.

A continuing thermal impact investigation of the physical, chemical, and biological conditions of Lake Michigan in the vicinity of the Kewaunee Nuclear Plant is reported to be used in determining the impact of the plant effluents on the aquatic environment. Information concerning near shore currents, water chemistry and bacteriology, phytoplankton, zooplankton, periphyton, benthos, fish, lake bottom topography, and shoreline erosion is presented. (FS)

4523 (KFK-1758) BEHAVIOR OF AEROSOLS IN CLOSED CONTAINERS (PARDISEKO-2). Keller, K. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Aug 1973. 21p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

An aerosol model was developed and a corresponding computer program (PARDISEKO II) written which permit prediction of the time behavior of aerosols in closed containers (e.g. reactor containments). The model includes the following elementary aerosol-mechanical processes: coagulation due to Brownian motion, diffusion to the walls of the container, sedimentation, thermophoresis at the containment walls, a continuous, time independent, source. The model achieves satisfactory agreement with experiments. (auth)

4524 (ORNL-tr-930) NUCLEAR SAFETY IN THE DESIGN OF POWER REACTORS. Eickelpasch, N. Translated from Atomkernenergie; 10: No. 5-6, 187-190(1965). 15p. Dep. NTIS $3.00.

The most important safety features of power reactors are listed and their mechanism of action is explained. The importance of the reactivity coefficients is illustrated in particular with the example of special reactor accidents. A concept of the order of magnitude of the safety factors cited is established. First, the essential processes which result in safety and their mechanism of action and order of magnitude are explained and discussed. Subsequently, operational disorders and reactor accidents are considered and the reaction of the reactor in such cases is illustrated by examples with special reference to pressurized and boiling water reactors. (auth)

4525 NUCLEAR SAFETY. Volume 14, No. 5. Cottrell, W. B.; Jordan, W. H.; Sheldon, M. R. (eds.). A Bimonthly Technical Progress Review Published for the Technical Information Center, USAEC. Oak Ridge, TN; Oak Ridge National Lab. (1973). 159p. GPO $0.60.

Separate abstracts were prepared for each of nine articles on nuclear reactor safety, operations involving radioactivity, and effects of nuclear fission operations on the environment. (HDR)

For abstracts of individual papers see: 2523, 2806, 2909, 3144, and 4526–4530.

4526 U. S. STUDIES ON LMFBR FUEL BEHAVIOR UNDER ACCIDENT CONDITIONS. Dickerman, C. E. (Argonne National Lab., IL). Nucl. Safety; 14: No. 5, 452-460(1973).

A brief review is presented of the U. S. effort, between fall 1969 and spring 1972, relating to evaluation of the behavior of the fuel and coolant in liquid-metal-cooled fast breeder reactors under accident conditions. The experimental work is centered largely around the Transient Reactor Test facility. Investigations of steady-state power operation suggest that safety and reliability can be attained even with partial blockages of coolant flow. Results of transient tests are less severe than predictions based on pessimistic assumptions, and additional effort is required to permit accurate modeling of detailed behavior. (auth)

4527 DESIGN AND EVALUATION OF FFTF CONTAINMENT. Simpson, D. E. (Westinghouse Electric Corp., Hanford, WA). Nucl. Safety; 14: No. 5, 470-481(1973).

The Fast Flux Test Facility has been the subject of an extensive regulatory review similar to that for power-reactor construction permits. The review extended from September 1970 to early 1973, but interim agreements allowed construction to proceed without delay. A major part of the review was directed to the containment design and the definition of appropriate bases for evaluating the containment for the liquid-metal-cooled fast breeder reactor system. Studies of hypothetical accidents were carried out for overpower and loss-of-cooling circumstances, arbitrarily neglecting reactor scram. Initial studies indicated an accident energy of 150 MW-sec of theoretically available work to be reasonably conservative; more recent studies, incorporating preliminary results of research and development based on the earlier studies, indicate that a much lower energy is more realistic. Analyses and scale-model tests show that the design can contain the energy at 150 MW-sec and maintain mechanical integrity, not only of the containment structure but also of the reactor vessel and the heat-transport system. (auth)

4528 MATERIALS PERFORMANCE AT NUCLEAR POWER PLANTS. Scott, R. L. Jr. (Oak Ridge National Lab., TN). Nucl. Safety; 14: No. 5, 507-511(1973).

Safety-related occurrences—failures, incidents, and deficiencies—reported by light-water-reactor nuclear power plants are reviewed for the period 1967–1972. The occurrences are limited, however, to those in which a material failure was involved. Tables are given for each year, indicating the facility and components involved, the cause of failure, and the area in which the deficiency originated (i.e., material selection, design, fabrication, installation, operation, or maintenance). Each incident is discussed, and areas in which materials performance can be improved are indicated. (auth)

4529 SAFETY-RELATED OCCURRENCES REPORTED IN APRIL AND MAY 1973. Casto, W. R. (comp.). (Oak Ridge National Lab., TN). Nucl. Safety; 14: No. 5, 512-515(1973).

4530 PROGRESS SUMMARY OF NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROJECTS. Sheldon, M. (comp.). (Oak Ridge National Lab., TN). Nucl. Safety; 14: No. 5, 516-524(1973).

Reactor Theory and Calculation

Refer also to abstracts 3673, 3682, 4475, 4500, and 4504.

4531 (BNL-50387) MULTI-LEVEL EFFECTS IN REACTOR CALCULATIONS AND THE PROBABILITY TABLE METHOD. Proceedings of the CSEWG Resonance Region Subcommittee Meeting Held at Brookhaven National Laboratory, May 8, 1972. Bhat, M. R. (ed.) (Brookhaven National Lab., Upton, N. Y.). Apr 1973. Contract AT(30-1)-16. 134p. (CONF-720524-; ENDF-187). Dep. NTIS $8.75.

Seven papers are included; separate abstracts were prepared for five papers. Two papers were previously prepared for NSA and appeared as 27:21967 and 27:07222. (LBS)

For abstracts of individual papers see: 3673, 4042, 4043, 4532, and 4533.

4532 (BNL-50387, pp 39-63) THEORETICAL CONSIDERATIONS PERTINENT TO THE TREATMENT OF UNRESOLVED RESONANCES. Hwang, R. N. (Argonne National Lab., IL). Apr 1973.

From meeting of the Resonance Region Subcommittee of CSEWG; Upton, New York, USA (8 May 1972).

In multi-level effects in reactor calculations and the probability table method.

Some fundamental aspects of problems concerning the statistical treatment of resonance absorption in the unresolved region for reactor physics applications are discussed. Problems associated with the self-shielding effect are examined. Various calculational methods are described with particular attention being devoted to cross-section sampling techniques. The role of the multilevel effect on reactor Doppler-effect analysis is discussed. (JWR)

4533 (BNL-50387, pp 65-77) RESONANCE TREATMENT IN REACTOR APPLICATIONS. Cowan, C. L. (Brookhaven National Lab., Upton, NY). Apr 1973.

From meeting of the Resonance Region Subcommitte of CSEWG; Upton, New York, USA (8 May 1972).

In multi-level effects in reactor calculations and the probability table method.

The treatment of resonances in ENDF/B-III is discussed. Some comparisons of multilevel and single level resonance treatments are reviewed. The effects of multilevel treatments on Doppler coefficients, capture-to-fission ratios, and other reactor parameters are examined. (JWR)

4534 (CONF-730324-, pp 37-39) SENSITIVITY AND EFFECTIVENESS OF SOME EXTENDED VOID-REACTIVITY MODELS. Garland, W. J. 1973.

From ANS Niagara–Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

4535 NUMERICAL METHOD FOR OPTIMIZATION OF HETEROGENEOUS NUCLEAR REACTORS BY MEANS OF BURNABLE POISON BLOCKS. Voronkov, A. V.; Chuyanov, V. A. At. Energ. (USSR); 34: No. 6, 475(Jun 1973). (In Russian).

A new method of solving the problem of selecting the optimal parameters of a burnable absorber which assures a given behavior with time of the thermal neutron usage of a plane cell $\theta(X,t)$ is presented. The solution utilizes a combined kinetic-diffusion method. The kinetic equation is solved precisely within the neutron absorber, and with a diffusion approximation in the rest of the cell. Besides decreasing the amount of calculation, by this method it is possible to localize the region of determining the optimal variants in the volume of the absorber, and hence, the sorting of different variants takes place only in this region. The absorbing element is a plane nonscattering absorber consisting of layers of different materials. It is shown that the function $\theta(X,t)$ is monotonic with respect to separate components of the directed vector X. For this type of function the functional $\phi(X)$ will always have a discontinuous derivative at the minimum point. The search can be continued to find the absolute mimimum, and not a relative minimum, as confirmed by a detailed study of the behavior of the function $\phi(X)$ over the entire region of change of the variables. (SJR)

4536 LARGE SCALE STABILITY IN THE STEADY-STATE OPERATION OF HETEROGENEOUS NUCLEAR REACTORS. Mikishev, V. V.; Trunin, Yu. F. At. Energ. (USSR); 34: No. 6, 481-483(Jun 1973). (In Russian).

In nuclear reactors operating under high heat fluxes the solid inactive elements (moderator, fuel cladding, elements of construction) can operate under large thermal fluxes as a result of convective heat transfer from fuel elements, heat transfer agent and gamma-ray heating. The characteristic time for heating up the inactive elements may be measured in seconds, that is, it is comparable with the decay of the delayed neutrons. The inactive elements contribute to neutron multiplication in the control zone of the reactor. Calculating the dynamic effect of the inactive elements is carried out by a set of differential equations describing the relatively slow processes in which the effects of the fuel and heat transfer agent are taken into account in the form of an instantaneous power contribution to the reactivity. Average values of thermal conductivity are taken to simplify the solution. The equations include two neutron kinetics equations, an equation for the reactivity, and an equation for the thermal balance in an inactive element. An analysis of these equations shows sufficient conditions for the asymptotic stability of the dynamic model of a heterogeneous reactor represented by the initial equations. Stability will occur at any initial disturbance of the steady-state operation and at any of the thermal delays encountered in the reactor. (SJR)

4537 COMBINED USE OF INTEGRAL AND DIFFERENTIAL MEASUREMENTS IN PROBLEMS OF NUCLEAR DATA FOR REACTORS. Usachev, L. N.; Bobkov, Yu. G. (Physical-Power Inst., Moscow). pp 139-147 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev,: Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The present state of the use of integral measurements in the problem of nuclear data for reactors is given. Parameters of the program available are presented. The view of the authors on the organization of the work in this field is expressed. (3 tables) (auth)

4538 INTEGRAL EXPERIMENT FOR OBTAINING NUCLEAR DATA. Yurova, L. N.; Bushuev, A. V. (Moscow Engineering Physics Inst.). pp 147-158 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The present paper deals with the possibilities for an integral experiment and ways for improving techniques of measuring the reaction rate ratio for the purpose of increasing the accuracy and decreasing the effects of systematic errors. (2 tables) (auth)

4539 SENSITIVITY OF THE THERMAL NEUTRON UTILIZATION FACTOR TO VARIATIONS OF THE MACROSCOPIC CROSS SECTION. Laletin, N. I. (Inst. of Atomic Energy, Moscow). pp 176-180 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The coefficients of the different effects of the macroscopic cross sections on the thermal utilization factor are estimated. Analysis is based on the approximations, that lead to the sample equations. (auth)

4540 EFFECT OF CHANGES IN THE MICROSCOPIC CROSS SECTION ON THE INTEGRAL CHARACTERISTICS OF THE THERMAL NEUTRON SPECTRUM. Trukhanov, G. Ya. (Inst. of Atomic Energy, Moscow). pp 181-187 of Neitronnaya Fizika. Chast' II. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P2.

The influence of variations in nuclear data on integral characteristics of the thermal neutron spectrum in a flat uranium–water–graphite cell is investigated. (2 tables) (auth)

Reactor Components and Accessories

Refer also to abstracts 2805, 2990, 3001, 3002, 3039, and 3097.

4541 (CEA-N-1631) ANALYSIS OF THE REACTIVITY COEFFICIENTS OF STRUCTURAL MATERIALS AT THE CENTER OF A FEW FAST CRITICAL ASSEMBLIES. Heindler, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). Apr 1973. 107p. (In French). Dep. NTIS (U. S. Sales Only) $7.50.

An analysis of multigroup capture cross sections of structural materials (Fe, Cr, Ni and stainless steel) is attempted, using measured reactivity coefficients of these materials at the core center of a number of fast critical assemblies (ZPR III, VERA, ERMINE, MASURCA). The difficulty of interpreting these experiments is shown; various hypothesis and approximations are examined concerning the homogenization of the media, sample finite size and resonance self-shielding, calculation of unperturbed and perturbed fluxes. Tentative conclusions are drawn on capture cross sections of structural materials. (auth)

4542 (CONF-730942-, pp vp Paper C 3/6) SOME EXPERIMENTAL/THEORETICAL RESULTS IN THE BUCKLING UNDER EXTERNAL PRESSURE OF CYLINDERS WITH VARIOUS END CLOSURES. Aylward, R. W.; Galletly, G. D.; Moffat, D. G. (Univ. of Liverpool). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The elastic buckling pressures of thin cylindrical shells closed by torispherical shells with axisymmetric cylindrical nozzles, and toriconical shells are presented. The loading considered was uniform external pressure and the shell combinations were machined and stress-relieved. The experiments constitute a useful addition to the relatively few experimental results available in the open literature on the buckling of nearly perfect shell combinations under external pressure. Theoretical buckling pressures were calculated using a digital computer program, based on the variational finite-difference technique known as BOSOR 3. For the models with the cylindrical nozzle/torispherical end combinations, three values of the ratio (nozzle diameter/cylinder diameter) and two values of the ratio (nozzle thickness/cylinder thickness) were taken. With the toriconical ends, the ratio of the radius of the torus to the cylinder diameter was selected as 0.2 and the angle of the cone was varied. The theoretical results indicate that both linear and non-linear buckling failures occur. (5 references) (auth)

4543 NECESSITY OF NUCLEAR DATA FOR THE CALCULATION OF REACTOR SHIELDS. Abagyan, A. A.; Dubinin, A. A.; Suvorov, A. P. (Moscow State Univ.). pp 18-25 of Neitronnaya Fizika. Chast' I. Gilelakh, V. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

From all-union conference on neutron physics; Kiev, USSR (24 May 1971). See CONF-710565-P1.

Requirements for nuclear data are discussed. The importance of this knowledge is shown for shielding total cross sections and elastic scattering angular distributions with high precision. A tentative precision of the required neutron interaction cross sections with nuclei is given. The incompleteness and low precision of nuclear data on secondary gamma-ray spectra accompanying radiative capture, nonelastic scattering, and some other processes of neutron interaction with nuclei are demonstrated. (1 figure) (auth)

Reactor Fuels

Refer also to abstracts 2993, 2996, 2998, 3000, 3004, 3038, 3147, and 4474.

4544 (CEA-R-4513) DETERMINATION OF IRRADIATION PARAMETERS FOR FUELS IN IN-PILE TESTS. Baudry, R.; Gaillet, G.; Gauthier, M.; Labrousse, M.; Le Tanno, C.; Paris, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Nov 1973. 41p. (In French). Dep. NTIS (U. S. Sales Only) $4.25.

The experimental techniques developed by the reactor service of Saclay are presented. These techniques are applied to fuels for all types of reactors. The essential aspects of current experimental work concern fission power and effective fission or capture cross sections of the fuel constituents in the neutron spectra of the test reactor. These measurements together with calculations on the behavior enable the fission power, specific burn-up, and fuel composition to be determined at any moment during the irradiation. (auth)

4545 (CONF-730942-) STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY. Volume 1. Reactor Core. Part C. Structural Analysis of Reactor Fuel and Cladding. Part D. Structural Analysis of Reactor Fuel Elements. Preprints of 2nd International Conference, Berlin, Germany, September 10–14, 1973. Jaeger, T. A. (comp.). (Commission of the European Communities, Brussels (Belgium); Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)). 1973. 432p. (In English and German).

Separate abstracts are included for each of the 50 papers presented concerning the structural analysis of reactor fuel and cladding. (DCC)

For abstracts of individual papers see: 2990, 4450–4455, 4460–4473, 4478–4482, 4488–4498, 4502, 4542, and 4546–4556.

4546 (CONF-730942-, pp vp Paper C 1/5) SIMPLE, REASONABLY ACCURATE MODEL FOR CALCULATING STRESSES IN THE LAYERS OF COATED FUEL PARTICLES DURING IRRADIATION. Martin, D. G. (Atomic Energy Research Establishment, Harwell, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

Explicit analytical expressions have been developed which enable the maximum stresses in the various layers of a triplex coated fuel particle (comprising coatings of inner pyrocarbon, silicon carbide and outer pyrocarbon respectively) to be calculated during the course of an isothermal irradiation, in terms of the physical properties of the layers and the inner and outer pressures acting on the coatings. The accuracy of these expressions is typically 1-2%. In order to derive these relations it was assumed that with the exception of the dimensional change rates under irradiation all materials' properties relating to the layers were cubic and independent of neutron dose; also that the deformation of the silicon carbide layer due to elastic and creep strains may be neglected. The quoted analytical equations, which enable stresses to be calculated very easily by hand, assume that for the pyrocarbon layers the dimensional change rates due to irradiation are the same at all points within a particular layer and are independent of neutron dose; also that the silicon carbide dimensional change rates may be neglected. However it is shown that by suitably modifying the values of the dimensional change rates used in the calculations any or all of these three assumptions may be eliminated. As a result the model can adequately handle any dimensional change data it is presented with; for example it can deal with situations for which pyrocarbon layers comprise material with different density, as is the case with inner pyrocarbon layers which are deposited from methane. (3 references) (auth)

4547 (CONF-730942-, pp vp Paper C 2/1) THEORETICAL ANALYSIS OF STRESS, STRAIN, AND FRACTURE FOR FAST REACTOR FUEL CLADDING UNDER CONSTANT POWER AND POWER-CYCLING CONDITIONS: VISCO-ELASTIC MODEL OF NUCLEAR FUEL-PIN BEHAVIOUR. Gittus, J. H. (United Kingdom Atomic Energy Authority, Springfields, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

In the model adopted for analysis, the strength of the pellet is entirely dictated by that of an outer crust within which irradiation-creep is dominant. The inner bound of the outer crust is the isotherm at which irradiation-creep and thermal creep become equal. The crust is assumed free from open radial cracks and in it, swelling due to fission-gas precipitation is negligible:

solid-fission-products are the only source of swelling. Irradiation-creep entirely dominates the plastic deformation of the cladding: like the pellet, the cladding swells even at zero stresses. (8 references) (auth)

4548 (CONF-730942-, pp vp Paper C 2/2) EXPERIMENTAL AND THEORETICAL ANALYSIS OF ANISOTROPIC MECHANICAL PROPERTIES OF ZIRCALOY FUEL ELEMENT CLADDINGS. Dressler, G.; Matucha, K. H.; Wincierz, P. (Metallgesellschaft AG, Frankfurt am Main). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

As a result of the thermomechanical treatment during production Zircaloy canning tubes always show pronounced textures, which lead to anisotropic mechanical properties. On the basis of the knowledge of the multiaxial operational in-pile stresses and their temporal changes the possibility of texture strengthening can be successfully used to optimize the performance of the fuel rods. The necessary supposition is a detailed experimental determination of the anisotropic mechanical properties in terms of the stress ratio α(α = axial stress: tangential stress) and the tube texture. Beyond that mathematical models which can be used for the core design and which take into account the material anisotropy have to be developed. The elastic deformation and the onset of plastic flow of Zircaloy canning tubes under biaxial stress conditions were measured by applying simultaneously compressive or tensile stresses in the axial tube direction and tangential stresses. The apparent Young's moduli E_a and E_t, taken from the stress-strain diagrams, have different values and vary with the stress ratio α. A similar stress and directional variation of the onset of flow was measured after passing the elastic region. The criteria valid for isotropic materials turned out to be not suited for a satisfactory description of the measured data and relations. (9 references) (auth)

4549 (CONF-730942-, pp vp Paper C 2/5) FINITE ELEMENT FRACTURE MECHANICS ANALYSIS OF CREEP RUPTURE OF FUEL ELEMENT CLADDING. Chopra, P. S. (Argonne National Lab., IL). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

A finite element fracture mechanics technique is applied for simulating the elevated temperature creep rupture behavior of initially defected austenitic stainless steel fuel element cladding. The basic analytical approach consists of determining total instantaneous strain energy release rates and the corresponding values of the stress intensity factor from sequential linear elastic finite element solutions and relating these to either an effective creep fracture toughness parameter or to creep crack growth rates obtained from test results. An initial application of this approach has been made to simulate the creep rupture behavior of initially defected type 316 austenitic stainless steel fuel element cladding in the 20% cold worked condition, tested at 650°C. (13 references) (auth)

4550 (CONF-730942-, pp vp Paper C 3/5) MECHANICAL EQUATION OF STATES: ITS DEVELOPMENT AND APPLICATION TO REACTOR STRUCTURAL MECHANICS. Gittus, J. H. (United Kingdom Atomic Energy Authority, Springfields, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

Stress-analysis techniques such as the finite-element method demand prediction techniques capable of forecasting creep-rate as a function of the instantaneous and previous values of temperature and stress at each node. To supply this requirement, for metals that creep by dislocation-movement, a Mechanical Equation of States (MEOS) has been developed from the theory of dislocation-interactions and compared with creep data. Parameter-values for the MEOS have been determined, in the case of a stainless steel, by stress-removal and stress-reversal (creep-fatigue) experiments. Both the plastic and anelastic (recoverable) components of creep-strain are predicted by the MEOS for any arbitrary history of temperatures and multiaxial stresses. Its predictions compare well with the actual results of stress-dip experiments. As part of this work, the modified Orowan equation has been fitted to creep data for 20 Cr-25 Ni-Niobium stabilized stainless steel. The stress-dip behavior predicted by the modified Orowan equation (with parameters so defined) resembles that measured red in actual stress-dip experiments. (8 references) (auth)

4551 (CONF-730942-, pp vp Paper D 1/5) THREE-DIMENSIONAL STUDY OF NUCLEAR FUEL ROD BEHAVIOR DURING STARTUP. Levy, S.; Wilkinson, J. P. D. (General Electric Co., Schenectady, NY). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

A three-dimensional finite element study is made of the behavior of cylindrical uranium dioxide fuel pellets during startup. The finite element code uses an 8-noded box element of arbitrary shape to build up the stiffness and stress characteristics by Gaussian integration. Plasticity is accounted for by the secant modulus approach. Friction between the pellet and the cladding can be introduced by springs between the relevant finite elements in each area. A new and unique feature of the analysis allows cracks to appear in the uranium dioxide fuel as it is heated and the growth of the cracks can be traced as a function of linear power generated in the rod. The code can predict such things as pellet deformations and the stress and strain distributions within the pellets and the cladding. (5 references) (auth)

4552 (CONF-730942-, pp vp Paper D 1/8) METHOD FOR THE NUMERICAL CALCULATION OF THE BEHAVIOR OF FUEL ELEMENTS. Wilmore, D.; Hayns, M. R. (Atomic Energy Research Establishment, Harwell, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The production of viable theoretical model for the complex thermomechanical interactions in a fuel element is very desirable in the light of the difficulty and expense involved in performing in-pile experiments. In particular a knowledge of the life-history of such a system is vital for estimates of pin endurance and failure mechanisms. The problem is divided into two distinct, though related parts: the empirical parameterization of the material properties such as creep, swelling and the thermal properties; and the purely mathematical problem of the solution of the resulting equations. A computer program which is sufficiently accurate and flexible to accommodate any particular parameterization which may be required is developed. Existing methods are based on inadequate numerical procedures which may lead to inaccuracies and instabilities. The present method avoids these difficulties by means of sophisticated matrix handling techniques which are extremely rapid and allow a detailed description of the system by the economic use of fine spatial and time steps. No iterative procedures are involved and there are therefore no difficulties in making first predictions, inaccuracies in which can lead to instability. The system of equations is linearized and then solved exactly by a specially developed technique. The errors involved in the linearization are of the same order, or smaller, than those inherent in the numerical approximations. (auth)

4553 (CONF-730942-, pp vp Paper D 2/2) PARAMETERS AFFECTING FAST REACTOR FUEL PIN BEHAVIOR. Matthews, J. R. (Atomic Energy Research Establishment, Harwell, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

Potential fast reactor fuels have been irradiated under constant or slowly varying conditions, with few rapid changes in power. An understanding of these irradiations is essential for the prediction of the behavior in power producing fast reactors, the optimization of fuel design, and the anticipation of power cycling effects. Present work on computer simulations (using the NERFS steady state model) is compared with experimental clad deformation profiles. The controlling phenomena are identified and areas where data are still needed defined. (12 references) (auth)

4554 (CONF-730942-, pp vp Paper D 3/2) INVESTIGATION ON VIBRATION BEHAVIOR AND DRIVING FORCES FOR FUEL ELEMENT MODELS IN PARALLEL FLOW. Ohlmer, E.; Schwemmle, R. (EURATOM, Ispra, Italy). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

Experiments on a fuel element model in the form of a simple three-rod bundle have been performed in water flow. The pressure difference fluctuations on the rod surface acting as the driving forces as well as the resulting lateral vibrations were measured by means of one instrumented rod. The pitch width of the bundle arrangement was varied and also the measurement direction of the instrumented rod. With this, the rod vibrations and pressure fluctuations could be determined in different directions with respect to the flow subchannels. In order to investigate the driving forces of the rod vibration in more detail, coherence and phase shift of the pressure fluctuations have been measured in the length direction. Finally, an attempt has been made to develop relations describing the influence of geometric parameters such as eccentricity and local hydraulic diameters of the flow cross sections with respect to the driving forces. (4 references) (auth)

4555 (CONF-730942-, pp vp Paper D 3/9) VIBRATION CODE FOR A FUEL PIN WITH HELICALLY WOUND WIRE SPACER. Chelli, L.; Orru, G.; Papa, G. (CNEN, Bologna). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

The code considers fuel pins consisting of bars subdivided lengthwise in segments of different mechanical characteristics corresponding to the various regions of a fast reactor. The fuel element proper is made up by a bundle of such pins. All the pins are fixed at one end by cylindrical hinges to the bundle container. To hold apart the pins from one another for cooling purposes, a steel wire is wound around each of them. The aim of the code is to evaluate the proper frequencies and modes of vibration of an inner pin of the bundle assuming that the other pins of the bundle are not taking part in the vibration. Therefore a pin surrounded by six similar ones is considered. Its motion in space is constrained by its hinge, its wire spacer making contact with the neighbouring pins and by the pin itself making contact with the six wires of the latter. (9 references) (auth)

4556 (CONF-730942-, pp vp Paper D 4/7) UNSTEADY THERMAL STRESSES IN A POLYGONAL PRISM WITH A CIRCULAR HOLE UNDER HEAT GENERATION. Takeuti, Y.; Noda, N. (Shizuoka Univ., Japan). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1969).

In designing some types of fuel elements, it is necessary to find thermal stresses in a continuous medium perforated by cylindrical channels of circular cross section. In order to set up the problem, assume that the strength and heat transfer calculation are based on the phenomena that occur in a typical unit lattice cell, and that the heat generation is uniform over the whole section. Therefore the problems reduce to solve the temperature and thermal stresses in a polygonal prism with a central circular hole under uniform heat generation and for insulated outer boundary. The problems considered are concerned with unsteady thermal stresses in a polygonal prism with a circular hole under an uniform heat generation; the solving process is divided into two basic steps. First, the heat conduction equation is solved by the technique of Laplace transform. Second, the plane thermoelastic problem is solved by use of the five elementary functions method. Throughout the treatment of both problems, in order to satisfy the boundary conditions, the point-matching technique is used in conjunction with the least square method. (4 references) (auth)

Reactor Control Systems

Refer also to abstract 2806.

4557 (CONF-730324-, pp 27-29) USE OF DAMPING PLATES FOR THE ATTENUATION OF REACTOR CONTROL ROD VIBRATION. Phase Two. Cormier, R. (Univ. of Ottawa). 1973.

From ANS Niagara–Finger Lakes Section student conference; Hamilton, Ontario, Canada (9 Mar 1973).

4558 (JUL-980-RG) EVALUATING THE CONTROL-ROD EFFICIENCY IN HIGH TEMPERATURE REACTORS WITH A THREE DIMENSIONAL DIFFUSION CODE, USING BOUNDARY CONDITIONS DETERMINED BY TRANSPORT THEORY. Neef, H. J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Jul 1973. 103p. (In German). Dep. NTIS (U. S. Sales Only) $7.25.

Thesis.

For the determination of control-rod efficiency in high temperature reactors with diffusion codes the boundary conditions for the regions of the absorbing rods must be known. On the other hand there is need of a three-dimensional diffusion code for an exact calculation. Starting with the integral neutron transport equation, a first collision formalism was developed to determine the boundary conditions. A comparison with S_N-calculation shows a good agreement. The boundary conditions determined by transport theory were used for the AVR and the PR 500 reactors in a three-dimensional diffusion code. In the PR 500, a pebble-bed reactor of OTTO (once through, then out)-type, it is possible to provide the bottom reflector with a neutron poison, without decreasing the k_{eff}-value of the unrodded reactor. When the absorber rods are inserted from the top, the flux peak is forced into the lower end of the reactor, making the poison effective. To obtain the same control-rod efficiency in comparison with the unpoisoned bottom reflector, the rods have to be inserted less deeply in the case of the poisoned bottom reflector. (auth)

4559 (ZJE-136) SINGLE-PURPOSE DIGITAL DEVICES FOR MEASURING AND CONTROLLING THE POWER AND PERIOD OF NUCLEAR REACTORS. Haniger, L. (Skoda, Plzen (Czechoslovakia). Zavod Jaderne Elektrarny). 1973. 133p. Dep. NTIS (U. S. Sales Only) $8.75.

Single-purpose digital devices used for measuring and controlling the power and period of nuclear reactors are discussed. Two devices of this type are described. The first is called SADIC, while the other one DICOR. Both have been developed in Czechoslovakia. For comparison purposes a 4th-order analog measuring device with moving detectors is presented. The properties of individual devices are given, thus enabling the designers an impartial evaluation of relative convenience of both devices for a particular nuclear reactor. (auth)

Nuclear Power Plant Economics

Refer also to abstract 4519.

4560 (CNEA-345) PARTICIPATION OF ARGENTINE INDUSTRY IN THE NUCLEAR POWER PLANT AT ATUCHA AND THE FUTURE. Baez, J. N.; Darnond, L.; Grasso, H.; Quihillalt, O. J.; Sarrate, M.; Wortman, O. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 15p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

Reactor Fuel Cycle Economics

Refer also to abstract 4449.

4561 (AEC-tr-7445) TECHNICAL AND ECONOMIC STATUS AND PROSPECTS FOR NUCLEAR ENERGY IN THE POWER ECONOMY OF THE FEDERAL REPUBLIC OF GERMANY. Part III. Nuclear Fuel Cycle. Lurf, G. May 1972. Translated From a German Report. 98p. Dep. NTIS $7.00.

The internal fuel cycle of nuclear power stations involves the processes that occur during the fuel's utilization in the reactor and is briefly discussed. The external cycle includes all processes before and after utilization from the mining to the reprocessing of burned-out fuels, including reutilization or final storage of radioactive materials. The fuel cycle of the light water reactor is primarily discussed, since it may be assumed that the LWR will remain dominant and by 1980 will represent more than 90% of the installed nuclear capacity in the BRD. Nuclear energy aspects discussed include: fuel supply, conversion, enrichment, fuel element fabrication, reprocessing, plutonium, and transport and storage. A survey of the BRD enterprises involved in the nuclear cycle is given. (72 references) (MCW)

4562 USE OF METALLIC URANIUM IN THE POWER CHANNELS OF URANIUM-GRAPHITE REACTORS. Zhirnov, A. D.; Sirotkin, A. P.; Bryunin, S. V.; Pushkarev, V. I.; Runin, V. I. At. Energ. (USSR); 34: No. 6, 479-481(Jun 1973). (In Russian).

It was established experimentally that in a fuel rod with 5% free internal volume it is possible to attain a fuel burnup of 15,000-20,000 MWd/ton of U. Porosity of the fuel, thickness of fuel element cladding (0.65 and 0.9 mm) and uranium enrichment (1 to 2.4%) were varied in calculating whether the costs of using metal in a reactor are comparable with using uranium dioxide as a fuel. With the use of 0, 10 and 15% porosities the metal exceeded the effective density of UO_2 in a lattice arrangement by factors of 2, 1.82 and 1.71 respectively. The fuel expense increases with increasing burnup because of the necessity of higher fuel enrichment at startup. The plant load use was 0.80. Normal capital return was 0.12. Various burnups are given as a function of fuel enrichment for UO_2 and metal U having 15% free volume. With the use of metallic uranium it is shown that costs are minimal at burnups of ~11,500 MWd/ton of U for a solid fuel rod, ~12,500 MWd/ton of U with 10% porosity in the fuel rod, and ~13,000 MWd/ton of U at 15% porosity. The initial enrichments in these three cases were 1.18, 1.21 and 1.23% respectively. For UO_2 the minimum costs are encountered at burnups of 20,000-22,000 MWd/ton of U at initial ^{235}U enrichments of 1.8-1.9%. However, the metal possesses some advantages over the oxide for use in power reactors, and its further development is recommended. (SJR)

Reactor Licensing and Regulation

4563 (DOCKET-50010-201) DRESDEN NUCLEAR POWER STATION, UNIT 1. Inoperability of 1A Core Spray Pump. (Commonwealth Edison Co., Chicago, Ill. (USA)). 25 Oct 1973. 3p. Dep. NTIS $3.00.

4564 (DOCKET-50206-242) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Report Re Safety Injection Initiation Which Occurred Following a Shutdown of the Turbine Generator. (Southern California Edison Co., Rosemead, Calif. (USA)). 22 Oct 1973. 8p. Dep. NTIS $3.00.

4565 (DOCKET-50206-244) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Nondestructive In-Service Inspection, June 1973. (Southern California Edison Co., Rosemead, Calif. (USA)). 19 Oct 1973. 198p. Dep. NTIS $12.00.

Selected components of the San Onofre, Unit 1, reactor primary coolant system were subjected to an in-service inspection during the June 1973 refueling outage. The techniques and test results of the examinations conducted on components and/or areas of the reactor pressure vessel, steam generators, reactor coolant pumps, pressurizer and associated coolant piping are described. Various nondestructive testing methods were used, including visual, liquid penetrant, mechanized and manual ultrasonic techniques. The components and/or areas examined were found to be free of any reportable indications with the exception of: visual indication on "B" steam generator manway bolt, visual indications on the pressurizer manway bolts, LP indications on "A" cold leg safe end material near the safe end to pipe weld, LP indication in the base metal of Loop "C" pump inlet elbow, LP indication near weld No. 28 on the pressurizer level sensing line addition, and LP indication on RTD 420C. The visual indication on the manway bolt of "B" steam generator was determined to be a forging flaw and not Code rejectable. The corrosion indications on the pressurizer manway bolts were examined and deemed not Code rejectable. Metallurgical analysis was conducted on one steam generator bolt. The indications were a combination of slight erosion and minor corrosion and deemed not Code rejectable. Light cosmetic grinding on the LP indications on the "A" cold leg safe end near the safe end-to-pipe weld revealed small pits which were not Code rejectable. The LP indication in the base metal of Loop "C" pump inlet elbow was ground 0.113 inches to remove the defect. This did not exceed the minimum wall thickness specified by the manufacturer. The LP indication on the pressurizer level sensing line was removed with a few strokes of a hand file and deemed insignificant and not Code rejectable. The LP indication on the installation of RTD 420C was removed by grinding and repair welding. (auth)

4566 (DOCKET-50206-246) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Incident Report: Safety Injection Initiation. (Southern California Edison Co., Rosemead, Calif. (USA)). 31 Oct 1973. 8p. Dep. NTIS $3.00.

4567 (DOCKET-50213-239) HADDAM NECK PLANT. Abnormal Occurrence Report No. AO-73-10: Failure of the Power Supply for the 480V Motor Control Center Number 5 to Automatically Transfer When the Preferred Feeder Selector Switch Position Was Changed. (Connecticut Yankee Atomic Power Co., East Hampton, Conn. (USA)). 19 Oct 1973. 2p. Dep. NTIS $3.00.

4568 (DOCKET-50213-242) HADDAM NECK PLANT. Abnormal Occurrence Report No. AO-73-9: Unsatisfactory Test of Timers Associated with the Emergency Diesel Generator/Core Cooling Systems. (Connecticut Yankee Atomic Power Co., East Hampton, Conn. (USA)). 9 Oct 1973. 1p. Dep. NTIS $3.00.

4569 (DOCKET-50219-338) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Shutdown Margin Tests. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 16 Oct 1973. 3p. Dep. NTIS $3.00.

4570 (DOCKET-50219-339) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Failure of a Nipple Connecting the Emergency Service Water Relief Valve to 1-3 Containment Spray Heat Exchanger. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 26 Oct 1973. 2p. Dep. NTIS $3.00.

4571 (DOCKET-50237-409) DRESDEN NUCLEAR POWER STATION, UNIT 2. Malfunction of Isolation Condenser Valve MO-2-1301-1. (Commonwealth Edison Co., Chicago, Ill. (USA)). 26 Oct 1973. 2p. Dep. NTIS $3.00.

4572 (DOCKET-50237-412) DRESDEN NUCLEAR POWER STATION, UNIT 2. Failure of HPCI Valves 2-2301-48 and 36. (Commonwealth Edison Co., Chicago, Ill. (USA)). 26 Oct 1973. 2p. Dep. NTIS $3.00.

4573 (DOCKET-50244-212) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report No. AO-73-9: Excessive Cooldown Rate; Abnormal Occurrence Report No. AO-73-10: Malfunction of Safety Injection Pump Suction Transfer from Boric Acid Storage Tanks to Refueling Water Tank. (Rochester Gas and Electric Corp., N. Y. (USA)). 31 Oct 1973. 7p. Dep. NTIS $3.00.

4574 (DOCKET-50245-302) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Preliminary Review of Feedwater Sparger. (Millstone Point Co., Hartford, Conn. (USA)). 17 Aug 1973. 12p. Dep. NTIS $3.00.

4575 (DOCKET-50245-304) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Special Report, Reactor Control Blade Evaluation, Supplement 2. (Millstone Point Co., Hartford, Conn. (USA)). 26 Oct 1973. 10p. Dep. NTIS $3.00.

4576 (DOCKET-50245-305) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Additional Information re Personnel Radiation Exposure Associated with Feedwater Sparger Repair Work. (Millstone Point Co., Hartford, Conn. (USA)). 22 Oct 1973. 3p. Dep. NTIS $3.00.

4577 (DOCKET-50247-143) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-3-2-12: During Maintenance of the Closure Mechanism of the 80′ Elevator Outer Door of the Vapor Container, the Inner Door Was Partially Opened for a Short Period. (Consolidated Edison Co. of New York, Inc., New York (USA)). 17 Sep 1973. 1p. Dep. NTIS $3.00.

4578 (DOCKET-50247-145) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-3-2-13: Unplanned Release of Gaseous and Particulate Radioactivity in the Primary Auxiliary Building. (Consolidated Edison Co. of New York, Inc., New York (USA)). 26 Oct 1973. 2p. Dep. NTIS $3.00.

4579 (DOCKET-50247-147) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence AO-3-2-14: Malfunction of a Pressurizer Code Safety Valve. (Consolidated Edison Co. of New York, Inc., New York (USA)). 19 Oct 1973. 1p. Dep. NTIS $3.00.

4580 (DOCKET-50247-148) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-3-2-14: Malfunction of Pressurizer Safety Valves. (Consolidated Edison Co. of New York, Inc., New York (USA)). 1 Nov 1973. 2p. Dep. NTIS $3.00.

4581 (DOCKET-50249-308) DRESDEN NUCLEAR POWER STATION, UNIT 3. HPCI Steam Line High Power Switch Out of Calibration. (Commonwealth Edison Co., Chicago, Ill. (USA)). 24 Oct 1973. 2p. Dep. NTIS $3.00.

4582 (DOCKET-50250-168) TURKEY POINT PLANT, UNITS 3 AND 4. Contingency Plan and Restoration of Cooling Facilities Cooling Canal System. (Florida Power and Light Co. (USA)). 13 Sep 1973. 13p. (DOCKET-50251-156). Dep. NTIS $3.00.

4583 (DOCKET-50250-176) TURKEY POINT PLANT, UNIT 3. Abnormal Occurrence Report No. 3-73-10: High Boron Concentration in the Boric Acid Storage Tanks and the Boron Injection Tank. (Florida Power and Light Co. (USA)). 26 Oct 1973. 3p. Dep. NTIS $3.00.

4584 (DOCKET-50254-275) QUAD-CITIES STATION, UNITS 1 AND 2. Abnormal Occurrence: Excessive Release of ^{131}I and Particulates from the Reactor Building Ventilation Stack. (Commonwealth Edison Co., Cordova, Ill. (USA)). 12 Oct 1973. 2p. (DOCKET-50265-263). Dep. NTIS $3.00.

On October 3 and 4, 1973, the release rate from the reactor building ventilation stack exceeded the limit for iodine-131 and particulates as set in the technical specifications. The release was primarily attributed to a steam leak on the Unit 1 RCIC testable check valve. The safety implications of the incident are not considered significant. (JWR)

4585 (DOCKET-50254-281) QUAD-CITIES STATION, UNITS 1 AND 2. Abnormal Occurrences: Four Occasions of Excessive Release of ^{131}I and Particulates with Half Lives Longer than 8 Days from the Reactor Building Vent Stacks. (Commonwealth Edison Co., Cordova, Ill. (USA)). 20 Oct 1973. 2p. (DOCKET-50265-268). Dep. NTIS $3.00.

4586 (DOCKET-50255-205) PALISADES NUCLEAR PLANT. Monthly Primary and Secondary Radioactivity and Effluent Report, August 1973. (Consumers Power Co., Jackson, Mich. (USA)). 1 Nov 1973. 3p. Dep. NTIS $3.00.

4587 (DOCKET-50259-184) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO 7325W: Failure of the Inner Rupture Diaphragm of the High Pressure Coolant Injection System. (Tennessee Valley Authority, Chattanooga (USA)). 15 Oct 1973. 2p. Dep. NTIS $3.00.

4588 (DOCKET-50259-185) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report BF EAO-7325W through -7330W: Fish Impingement Estimates. (Tennessee Valley Authority, Chattanooga (USA)). 15 Oct 1973. 2p. Dep. NTIS $3.00.

4589 (DOCKET-50259-192) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report BF EAO-7325W through -7330W re Fish Killed when Impinged on Intake Screens. (Tennessee Valley Authority, Chattanooga (USA)). 15 Oct 1973. 2p. Dep. NTIS $3.00.

4590 (DOCKET-50259-195) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7323W: Malfunction of Turbine Condenser Low-Vacuum Switches PS-2-1A and 1D. (Tennessee Valley Authority, Chattanooga (USA)). 19 Oct 1973. 2p. Dep. NTIS $3.00.

4591 (DOCKET-50259-196) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7322W: Malfunction of Reactor Water Level Switches L1S-3-203B and C. (Tennessee Valley Authority, Chattanooga (USA)). 19 Oct 1973. 2p. Dep. NTIS $3.00.

4592 (DOCKET-50259-200) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report BF EAO-7331W through 7336W: Notice of Fish Killed When Impinged on Intake Screens. (Tennessee Valley Authority, Chattanooga (USA)). 24 Oct 1973. 2p. Dep. NTIS $3.00.

4593 (DOCKET-50259-204) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. BFAO-7330W: Release to the River of Approximately 1,400 Gallons of Unanalyzed Liquid Radwaste on October 19, 1973. (Tennessee Valley Authority, Chattanooga (USA)). 29 Oct 1973. 2p. Dep. NTIS $3.00.

4594 (DOCKET-50259-205) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. BFAO-7327W: Malfunction of Recirculation Jet Pump Riser d/p Switch PdIS-68-24. (Tennessee Valley Authority, Chattanooga (USA)). 26 Oct 1973. 2p. Dep. NTIS $3.00.

4595 (DOCKET-50259-206) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. BFAO-7329W: HPCI Inverter Power Supply Fuse Failure. (Tennessee Valley Authority, Chattanooga (USA)). 26 Oct 1973. 2p. Dep. NTIS $3.00.

4596 (DOCKET-50259-212) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report BF EAO-7337W through 7343W: Fish Impingement Estimates. (Tennessee Valley Authority, Chattanooga (USA)). 2 Nov 1973. 2p. Dep. NTIS $3.00.

4597 (DOCKET-50259-213) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7331W: Malfunction of Two Turbine Condenser Low Vacuum Switches. (Tennessee Valley Authority, Chattanooga (USA)). 2 Nov 1973. 2p. Dep. NTIS $3.00.

4598 (DOCKET-50259-217) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. BFAO 7332W. (Tennessee Valley Authority, Chattanooga (USA)). 9 Nov 1973. 3p. Dep. NTIS $3.00.

4599 (DOCKET-50261-264) H. B. ROBINSON PLANT, UNIT 2. Abnormal Occurrence: Violation of Steam Flow Setpoints. (Carolina Power and Light Co., Raleigh, N.C. (USA)). 23 Oct 1973. 1p. Dep. NTIS $3.00.

4600 (DOCKET-50261-266) H. B. ROBINSON PLANT, UNIT 2. Monthly Report of Primary and Secondary Activity Measurements and Effluent Discharge Activity Levels. (Carolina Power and Light Co., Raleigh, N.C. (USA)). 7 Aug 1973. 2p. Dep. NTIS $3.00.

4601 (DOCKET-50261-277) H. B. ROBINSON PLANT, UNIT 2. Abnormal Occurrence: Violation of Steam Flow Setpoints. (Carolina Power and Light Co., Raleigh, N.C. (USA)). 31 Oct 1973. 3p. Dep. NTIS $3.00.

4602 (DOCKET-50263-253) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Identification and Inspection of Defective Hydraulic Shock Suppressors and Restraints. (Northern States Power Co., Minneapolis, Minn. (USA)). 5 Sep 1973. 5p. Dep. NTIS $3.00.

4603 (DOCKET-50263-254) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence: Temporary Loss of No. 1AR Transformer. (Northern States Power Co., Minneapolis, Minn. (USA)). 18 Sep 1973. 1p. Dep. NTIS $3.00.

4604 (DOCKET-50263-257) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence: Inadvertent Omission of Required Surveillance Test during Diesel Generator Servicing. (Northern States Power Co., Minneapolis, Minn. (USA)). 5 Oct 1973. 2p. Dep. NTIS $3.00.

4605 (DOCKET-50263-258) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Environmental Monitoring and Ecological Studies Program, Annual Report 1972. (Northern States Power Co., Minneapolis, Minn. (USA)). 10 Oct 1973. 576p. Dep. NTIS $31.00.

Background radiation monitoring and ecological studies in the plant area are presented. Radiation monitoring includes the results of the analysis of environmental samples. Records of film badge background radiation exposure at on-site and off-site locations are given. The ecological studies include studies of the Mississippi River and results of chemical analyses of water samples. (FS)

4606 (DOCKET-50265-272) QUAD-CITIES STATION, UNIT 2. Abnormal Occurrence: Failure of an Emergency Power System Component. (Commonwealth Edison Co., Cordova, Ill. (USA)). 29 Oct 1973. 2p. Dep. NTIS $3.00.

4607 (DOCKET-50265-273) QUAD-CITIES STATION, UNIT 2. Abnormal Occurrence: Failure of Main Steam Isolation Valve Pilot. (Commonwealth Edison Co., Cordova, Ill. (USA)). 29 Oct 1973. 4p. Dep. NTIS $3.00.

4608 (DOCKET-50266-130) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Backseating Disc Mislocation Problem on 2 Inch Darling Valves. (Wisconsin Electric Power Co., Milwaukee (USA)). 29 Oct 1973. 3p. (DOCKET-50301-114). Dep. NTIS $3.00.

4609 (DOCKET-50267-83) FORT ST. VRAIN NUCLEAR GENERATING STATION. Progress Report on the Proposed Ecological Monitoring Plan, March 1, 1973. (Public Service Co. of Colorado, Denver (USA)). 29 Oct 1973. 37p. Dep. NTIS $4.00.

Proposed monitoring plans to be initiated in May 1973 concerning aquatic, avian, terrestrial, and soil ecosystems; plant communities; invertebrates; mammals, reptiles, and amphibians; and heavy metals are presented. (FS)

4610 (DOCKET-50269-155) OCONEE NUCLEAR STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-7: Breakers to the Motor Operators on CF-1 and -2, the Core Flood Tank Discharge Valves, Locked in the Closed Position. (Duke Power Co., Charlotte, N.C. (USA)). 17 Oct 1973. 2p. Dep. NTIS $3.00.

4611 (DOCKET-50269-156) OCONEE NUCLEAR STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-5: Control Rod Withdrawal Limits Were Exceeded. (Duke Power Co., Charlotte, N.C. (USA)). 16 Oct 1973. 3p. Dep. NTIS $3.00.

4612 (DOCKET-50269-160) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Unusual Event: Liquid and Gas Waste Management Systems Are Processing Larger Volumes of Fluids Than Were Estimated. (Duke Power Co., Charlotte, N.C. (USA)). 26 Oct 1973. 2p. (DOCKET-50270-127; DOCKET-50287-104). Dep. NTIS $3.00.

4613 (DOCKET-50269-161) OCONEE NUCLEAR STATION, UNIT 1. Unusual Event Report No. UE-73-10, Malfunction of Discharge Valve HP-27. (Duke Power Co., Charlotte, N. C. (USA)). 2 Nov 1973. 2p. Dep. NTIS $3.00.

4614 (DOCKET-50271-231) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report No. AO-73-28: Malfunction of a Microswitch Installed in DPIS 2-129B. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 18 Sep 1973. 2p. Dep. NTIS $3.00.

4615 (DOCKET-50271-240) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report No. AO-73-24: Instrument Lines Monitoring Suppression Chambers Pressure Were Incorrectly Tubed to the Differential Pressure Sensors Which Activate Breaker Operation. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 17 Aug 1973. 2p. Dep. NTIS $3.00.

4616 (DOCKET-50271-242) VERMONT YANKEE NUCLEAR POWER STATION. Analysis of the Effects of Inverted Control Blade Absorber Tubes on Operation. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 19 Oct 1973. 5p. Dep. NTIS $3.00.

4617 (DOCKET-50271-244) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report No. AO-73-25: A Direct Lightning Strike to the Top of the Plant Ventilation Stack Resulted in Both Plant Stack Gas Monitoring Systems and the Area Gamma Radiation Monitor on the Perimeter Fence Becoming Inoperable. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 31 Aug 1973. 2p. Dep. NTIS $3.00.

4618 (DOCKET-50271-248) VERMONT YANKEE NUCLEAR POWER STATION. Incident Report: While Performing a Control Rod Friction Drive Test on One Control Rod With the Reactor Vessel Head Removed, a Scram Occurred. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 9 Nov 1973. 2p. Dep. NTIS $3.00.

4619 (DOCKET-50271-250) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report No. AO-73-31: a Control Rod Withdrawal Error Resulted in a Reactor Scram. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 8 Nov 1973. 2p. Dep. NTIS $3.00.

4620 (DOCKET-50277-132) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrences: Set Point Deviation and Switch Deficiencies. (Philadelphia Electric Co., Pa. (USA)). 14 Sep 1973. 4p. Dep. NTIS $3.00.

4621 (DOCKET-50277-136) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Safety Analysis of Relief Valve Set Pressure Changes. (Philadelphia Electric Co., Pa. (USA)). 5 Oct 1973. 5p. (DOCKET-50278-105). Dep. NTIS $3.00.

4622 (DOCKET-50277-141) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence: MSIV Limit Switch Failure and Spray Pump Room Cooler Failure. (Philadelphia Electric Co., Pa. (USA)). 18 Oct 1973. 3p. Dep. NTIS $3.00.

4623 (DOCKET-50277-151) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Significant Deficiency Report No. SDR-5, High Pressure Service Water Valve Weld Failure. (Philadelphia Electric Co., Pa. (USA)). 26 Oct 1973. 6p. (DOCKET-50278-111). Dep. NTIS $3.00.

4624 (DOCKET-50277-152) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence: Three Instrument Deficiencies and a Primary System Relief Valve Bellows Leak Indication. (Philadelphia Electric Co., Pa. (USA)). 31 Oct 1973. 5p. Dep. NTIS $3.00.

4625 (DOCKET-50280-186) SURRY POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-S1-73-10: Failure of Solenoid on TV-MS-101C C Mainsteam Trip Valve Circuit. (Virginia Electric and Power Co., Richmond). 16 Oct 1973. 6p. Dep. NTIS $3.00.

4626 (DOCKET-50280-189) SURRY POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-S1-72-05: RTD Ejection From Reactor Coolant System Bypass Manifold. (Virginia Electric and Power Co., Richmond (USA)). 31 Oct 1973. 7p. Dep. NTIS $3.00.

4627 (DOCKET-50281-156) SURRY POWER STATION, UNIT 2. Abnormal Occurrence Report No. AO-S2-73-09: Failure of Main Steam Line Trip Valve, TV-MS-201C. (Virginia Electric and Power Co., Richmond (USA)). 2 Nov 1973. 7p. Dep. NTIS $3.00.

4628 (DOCKET-50281-157) SURRY POWER STATION, UNIT 2. Abnormal Occurrence Report No. AO-S2-73-08: Failure of Level Comparator LC-2-474B to De-energize. (Virginia Electric and Power Co., Richmond (USA)). Nov 1973. 6p. Dep. NTIS $3.00.

4629 (DOCKET-50285-136) FORT CALHOUN STATION, UNIT 1. Unusual Event Report No. 73-6: Circuit Error in the Power Ratio Calculator. (Omaha Public Power District, Nebr. (USA)). 8 Nov 1973. 3p. Dep. NTIS $3.00.

4630 (DOCKET-50285-137) FORT CALHOUN STATION, UNIT 1. Unusual Event Report No. 73-7: Failure of Auxiliary Feedwater Pump (FW-10) to Start. (Omaha Public Power District, Nebr. (USA)). 13 Nov 1973. 3p. Dep. NTIS $3.00.

4631 (DOCKET-50286-99) INDIAN POINT STATION, UNIT 3. Annual Report on Hudson River Ecological Study, April–December 1972. (Consolidated Edison Co. of New York, Inc., New York (USA)). Apr 1973. 455p. Dep. NTIS $24.75.

The analysis and interpretation of data collected in the Hudson estuary from April through December 1972 are presented concerning benthic ecology, fish behavior and physiology, fisheries population ecology, fisheries sampling program, tag and recapture evaluation, physical and chemistry program, and biological and morphological characteristics. The types of fish intensively studied were striped bass and white perch. (FS)

4632 (DOCKET-50289-130) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Incident Report: Wetting of the Building Spray Pumps BS-P-1A and 1B and Limitorque Valve Operators DH-V-6A and BS-V-3B. (Metropolitan Edison Co., Reading, Pa. (USA)). 24 Oct 1972. 3p. Dep. NTIS $3.00.

4633 (DOCKET-50289-135) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Failure of Stems on Core Flood Valves. (Metropolitan Edison Co., Reading, PA (USA)). 1 Nov 1973. 3p. Dep. NTIS $3.00.

4634 (DOCKET-50289-137) THREE MILE ISLAND NUCLEAR STATION, UNITS 1 AND 2. Incomplete Chemical Analysis Performed on Pressure Boundary Parts of Stainless Steel Valves. (Metropolitan Edison Co., Reading, PA 'USA)). 1 Nov 1973. 3p. (DOCKET-50320-57). Dep. NTIS $3.00.

4635 (DOCKET-50293-198) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-34: Minor Set Point Drifts of Barksdale and Barton Pressure Switches. (Boston Edison Co., Mass. (USA)). 24 Oct 1973. 1p. Dep. NTIS $3.00.

4636 (DOCKET-50293-199) PILGRIM NUCLEAR POWER STATION, UNIT 1. Information Report on Control Rod 34-15. (Columbia-National Corp., Cambridge, Mass. (USA)). 25 Oct 1973. 2p. Dep. NTIS $3.00.

4637 (DOCKET-50295-192) ZION NUCLEAR PLANT, UNIT 1. Leak in Weld Channel Pressurization System. (Commonwealth Edison Co., Chicago, Ill. (USA)). 1 Nov 1973. 2p. Dep. NTIS $3.00.

4638 (DOCKET-50298-97) COOPER NUCLEAR STATION. Abnormal Occurrence: Breaker EG2 Failure. (Nebraska Public Power District, Columbus (USA)). 26 Oct 1973. 4p. Dep. NTIS $3.00.

4639 (DOCKET-50305-120) KEWAUNEE NUCLEAR POWER PLANT. Intermittent Malfunction of Convertible Pole Magnetic Relay Contacts to Close 4160 Volt Breakers on the Safeguards Bus. (Wisconsin Public Service Corp., Green Bay (USA)). 8 Oct 1973. 2p. Dep. NTIS $3.00.

4640 (DOCKET-50305-121) KEWAUNEE NUCLEAR POWER PLANT. Modification of Solenoid Valve Design. (Wisconsin Public Service Corp., Green Bay (USA)). 1 Nov 1973. 2p. Dep. NTIS $3.00.

4641 (DOCKET-50305-122) KEWAUNEE NUCLEAR POWER PLANT. Safety Injection Pump Modification. (Wisconsin Public Service Corp., Green Bay (USA)). 2 Nov 1973. 2p. Dep. NTIS $3.00.

4642 (DOCKET-50309-142) MAINE YANKEE ATOMIC POWER PLANT. Unusual Event: A 125VDC Bus Ground Alarm Revealed the Ground to Be on Battery Bus No. 1 Resulting in a Reactor Trip. (Maine Yankee Atomic Power Co., Wiscasset (USA)). 10 Oct 1973. 2p. Dep. NTIS $3.00.

4643 (DOCKET-50309-146) MAINE YANKEE ATOMIC POWER PLANT. Abnormal Occurrence Report AO-73-3: Malfunction of Barton Main Coolant Flow Transmitters. (Maine Yankee Atomic Power Co., Westboro, Mass. (USA)). 28 Sep 1973. 1p. Dep. NTIS $3.00.

4644 (DOCKET-50313-113) ARKANSAS NUCLEAR ONE, UNIT 1. Final Report on Loss of Power to Vital Busses. (Arkansas Power and Light Co., Pine Bluff (USA)). 17 Oct 1973. 4p. Dep. NTIS $3.00.

4645 (DOCKET-50315-148) DONALD C. COOK NUCLEAR POWER PLANT, UNIT 1. Report of the Investigation of Defective Nozzle-to-Header Welds on the Main Steam Safety Valve Headers. (American Electric Power Service Corp., New York). 9 Oct 1973. 27p. Dep. NTIS $3.50.

4646 (DOCKET-50317-131) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Interim Report on Nonconformance Re Discolored Thermocouple Wells in the Stainless Steel Chemical and Volume Control System. (Baltimore Gas and Electric Co., Md. (USA)). 25 Sep 1973. 3p. (DOCKET-50318-115). Dep. NTIS $3.00.

4647 (DOCKET-50321-101) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Control Rod Drop Accident and Core Thermal Power Level. (Georgia Power Co., Atlanta (USA)). 25 Oct 1973. 2p. Dep. NTIS $3.00.

4648 (DOCKET-50327-60) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Interim Report on Potential Design Deficiency re Design Strength for the Concrete Mix for the Reactor Building Interior Concrete Structure. (Tennessee Valley Authority, Chattanooga (USA)). 29 Oct 1973. 4p. (DOCKET-50328-53). Dep. NTIS $3.00.

4649 (DOCKET-50331-123) DUANE ARNOLD ENERGY CENTER. Environmental Monitoring Program, Quarterly Report, April 1, 1973–June 30, 1973. (Iowa Electric Light and Power Co., Cedar Rapids (USA)). 23 Oct 1973. 45p. Dep. NTIS $4.25.

Background radiation ranged from 1.06 to 2.84 mrem/week with an average of 1.60 mrem/week and is within ranges previously observed. The concentrations of airborne particulate radioactivity remained low. Gross B activity ranged from 1.01 to 0.04 pCi/m^3. The predominant γ emitter was ^{7}Be from cosmic ray bombardment. Gross β radioactivity for surface water remained at low levels. Concentration of tritium in surface water was below 300 pCi/liter, while ^{90}Sr ranged up to 1.8 Ci/liter. Two ground water samples exceeded the gross α or β control limits of 3 pCi/liter and 10 pCi/liter. ^{226}Ra and ^{90}Sr and γ emitters were below the limits for drinking water. Natural ^{40}K was the major radionuclide detected in meat. A trace of ^{137}Cs from fallout was detected. The concentration of ^{90}Sr in milk ranged from 2.0 to 23.8 pCi/liter with the highest levels found in June. Gamma emitters were below detectable levels except for natural ^{40}K and ^{137}Cs. Samples of fish did not contain significant amounts of any γ emitters except ^{40}K. Samples of aquatic biota were not collected. ^{90}Sr was measured in soils with concentrations ranging up to 0.78 pCi/g (dry). Natural ^{40}K, traces of U, thorium, and ^{137}Cs which ranged up to 0.54 pCi/g (dry) were found in soils. ^{90}Sr and ^{137}Cs are attributable to world wide fallout. (FS)

4650 (DOCKET-50334-89) BEAVER VALLEY POWER STATION, Unit 1. Problem Reports P-20 and B-1 Re Indications Discovered in the Safe-End Buttering of "C" Steam Generator Outlet Nozzle. (Duquesne Light Co., Pittsburgh, Pa. (USA)). 4 Oct 1973. 7p. Dep. NTIS $3.00.

4651 (DOCKET-50336-83) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Deficiency Report No. 6, Examination of Bonnet Areas of ¾ Inch, 1500 Rate Stainless Steel Valves Have Indicated Possible Presence of Cracks or Linear Discontinuances. (Millstone Point Co., Hartford, Conn. (USA)). 26 Oct 1973. 3p. Dep. NTIS $3.00.

4652 (DOCKET-50409-74) LA CROSSE BOILING WATER REACTOR. Fuel Performance and Refueling Plans. (Dairyland Power Cooperative, La Crosse, Wis. (USA)). 4 Oct 1973. 5p. Dep. NTIS $3.00.

4653 (DOCKET-50409-75) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report, August 1973. (Dairyland Power Cooperative, La Crosse, Wis. (USA)). Aug 1973. Contract AT(11-1)-851. 31p. (DPC-851-63). Dep. NTIS $3.75.

The reactor was critical for 727.2 hours at an average power level of 91%, 150 MW(t), with the turbine-generator connected to the grid for 711.2 hours. Four reactor scrams occurred during the period, three at power and one scram occurred during plant startup. In this power range, reactor power normally increases as total forced recirculation flow is increased. A similar experience was noted in January 1972, however, the apparent power to flow anomaly occurred at a slightly lower flow rate. Two Control Rod Drive Mechanisms failed to insert by the hydraulic scram motor on two separate occasions. Both inserted electrically at shim speed, as designed. The seal injection system caused an isolated scram. The seal injection pump relief valve will be replaced at the first opportunity as it was judged to be the cause. (auth)

4654 (DOCKET-50443-19) SEABROOK NUCLEAR STATION, UNITS 1 AND 2. Hydrographic Data Report, February–May 1973. (Public Service Co. of New Hampshire, Manchester (USA)). 18 Jul 1973. 31p. (DOCKET-50444-19). Dep. NTIS $3.75.

4655 (DOCKET-50458-2) RIVER BEND STATION, UNITS 1 AND 2. License Application, PSAR, Volume 1. (Gulf States Utilities Co., Beaumont, Tex. (USA)). 1973. 607p. (DOCKET-50459-2). Dep. NTIS $32.50.

The boiling water reactors each have a rated core power of 2,894 MW(t) and a net electrical output of ~934 MW(e). The safety analysis core power is 3,039 MW(t) (105% of the rated thermal power) and is the power level used for plant safety analysis. The containment is a free standing steel structure in the form of a right circular cylinder with an ellipsoidal dome and a flat bottom. The shield building is a right circular cylinder with a constant radius dome and is separated from the containment. The reactor site is on the east bank of the Mississippi River 24 miles N-NW of Baton Rouge, La. The geography, demography, meteorology, hydrology, geology, seismology, and nearby industrial, transportation and military facilities of the site are described. (FS)

4656 (DOCKET-50458-3) RIVER BEND STATION, UNITS 1 AND 2. License Application, PSAR, Volume 2. (Gulf States Utilities Co., Beaumont, Tex. (USA)). 1973. 468p. (DOCKET-50459-3). Dep. NTIS $25.50.

Information is presented concerning aerial photographic and topographic interpretation procedures, boring logs, seismic field test data, seismic fault data, the St. Tammany fault, chronological listing and descriptions of earthquakes within 200 miles of the site, grain size and Atterberg limits test of soil from bore holes, soil testing of undisturbed samples and tertiary clays, investigation of sources for select fill materials, and soil testing of sand samples. (FS)

4657 (DOCKET-50458-4) RIVER BEND STATION, UNITS 1 AND 2. License Application, PSAR, Volume 3. (Gulf States Utilities Co., Beaumont, Tex. (USA)). 1973. 548p. (DOCKET-50459-4). Dep. NTIS $29.50.

An evaluation of the design bases measured against AEC General Design Criteria is made. Information is presented concerning the classification of structures, components, systems, and equipment; wind and tornado loadings, water level (flood) design; missile protection; protection against dynamic effects associated with postulated pipe rupture; seismic design; design of Category I structures; mechanical systems and components, seismic design of Category I instrumentation and electrical equipment; environmental design of mechanical and electric equipment; and separation criteria for safety related mechanical and electric equipment. The appendices include computer programs for stress analysis of the steel containment system and computer programs used in dynamic and static analysis. (FS)

4658 (DOCKET-50458-5) RIVER BEND STATION, UNITS 1 AND 2. License Application, PSAR, Volume 4. (Gulf States Utilities Co., Beaumont, Tex. (USA)). 1973. 662p. (DOCKET-50459-5). Dep. NTIS $32.25.

The reactor assembly, which consists of the reactor vessel, internal components of the core, shroud, steam separator and dryer assemblies, jet pumps, control rods, control rod drives and housing, is described. The reactor cooling system and related systems, consisting of the systems and components which contain or transport fluid to and from the core, are presented. The integrity of the reactor coolant pressure boundary, thermal hydraulic system, reactor appurtenances, components and subsystems, and required instrumentation are presented. The engineered safety features, including the containment system, ECCS, habitability systems, the nuclear pressure relief system, main steam line isolation valves and flow restrictors, control rod drive housing support system and flow restrictors, and the standby liquid control system, are discussed. (FS)

4659 (DOCKET-50458-6) RIVER BEND STATION, UNITS 1 AND 2. License Application, PSAR, Volume 5. (Gulf States Utilities Co., Beaumont, Tex. (USA)). 1973. 565p. (DOCKET-50459-6). Dep. NTIS $30.25.

Information is presented concerning reactor protection systems, engineered safety systems, systems required for safe shutdown, safety related display systems, all other systems required for safety, and control systems not required for safety. (FS)

4660 (DOCKET-50458-7) RIVER BEND STATION, UNITS 1 AND 2. License Application, PSAR, Volume 6. (Gulf States Utilities Co., Beaumont, Tex. (USA)). 1973. 608p. (DOCKET-50459-7). Dep. NTIS $32.50.

Information is presented concerning onsite and offsite power; fuel storage and handling; water systems; process auxiliaries; heating, cooling, air conditioning; ventilation; turbine-generator; main steam supply system; management of liquid, gaseous, and solid wastes; process, effluent, and off site monitoring programs; environmental models; shielding; health physics programs; organization of the applicant; training programs; review and audit; plant procedures; plant records; industrial security; test program, and staff augmentation for initial tests and start-up. (FS)

4661 (DOCKET-50458-8) RIVER BEND STATION, UNITS 1 AND 2. License Application, PSAR, Volume 7. (Gulf States Utilities Co., Beaumont, Tex. (USA)). 1973. 641p. (DOCKET-50459-8). Dep. NTIS $34.25.

Information is presented concerning reactor accidents including a study of main steam isolation valve leakage; specification definitions; safety limits and limiting safety system settings; limiting conditions of operation; surveillance requirements; design features; administrative controls; and quality assurance during design and construction. (FS)

4662 (DOCKET-50458-9) RIVER BEND STATION, UNITS 1 AND 2. Environmental Report, Construction Permit Stage, Volume 1. (Gulf States Utilities Co., Beaumont, Tex. (USA)). 1973. 539p. (DOCKET-50459-9). Dep. NTIS $29.00.

The environmental effects of construction and operation of the River Bend Station, Units 1 and 2 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; and the need for power; of the proposed plant operation. (FS)

4663 (DOCKET-50458-10) RIVER BEND STATION, UNITS 1 AND 2. Environmental Report, Construction Permit Stage, Volume 2. (Gulf States Utilities Co., Beaumont, Tex. (USA)). 1973. 563p. (DOCKET-50459-10). Dep. NTIS $30.25.

Information is presented concerning plant operation, accident, economic, and social effects on the environment; monitoring programs; and alternate sites and plant designs. (FS)

4664 (DOCKET-50458-11) RIVER BEND STATION, UNITS 1 AND 2. Environmental Report, Construction Permit Stage, Volume 3. (Gulf States Utilities Co., Beaumont, Tex. (USA)). 1973. 553p. (DOCKET-50459-11). Dep. NTIS $29.75.

Information is presented concerning cost benefit analysis and environmental approvals and consultation. The following appendices are included: Southwest Power Pool Reliability and Adequacy of Electric Power 1972-81; archaeological survey of River Bend; hydrographic studies; terrestrial biota of River Bend site; synopsis of reproductive data of major fishes in River Bend Area; specifications for right-of-way clearing; environmental models; probability classification explanation; public attitude toward nuclear plants; fauna likely to appear on alternate sites; newspaper and magazine articles on River Bend; and basic data for source term calculations. (FS)

4665 (DOCKET-50458-12) RIVER BEND STATION, UNITS 1 AND 2. License Application, Anti-Trust Review Information. (Gulf States Utilities Co., Beaumont, Tex. (USA)). 1973. 48p. (DOCKET-50459-12). Dep. NTIS $4.50.

4666 (DOCKET-STN-50437-14) OFFSHORE POWER SYSTEMS. Interim Description of Revisions to Floating Nuclear Plant Arrangement and Ice Condenser Design. Engineering Drawings. (Offshore Power Systems, Jacksonville, Fla. (USA)). 26 Oct 1973. 631p. Dep. NTIS $33.75.

Changes in arrangement and layout are described and the reasons for the change, magnitude of the change, and the resultant effects with regard to plant safety and plant site interface are explained. The new plant arrangement establishes satisfactory conditions of trim and list. The containment and three major watertight compartments, which contain vital safety equipment, are relocated. (FS)

4667 (RDT-STATUS-9-73) BIMONTHLY STATUS REPORT: RDT STANDARDS. Summary as of September 28, 1973. (USAEC Division of Reactor Development and Technology, Washington, D.C.). 19 Oct 1973. 52p. RSO.

4668 SUPPLEMENTARY QUALITY ASSURANCE REQUIREMENTS FOR INSTALLATION, INSPECTION, AND TESTING OF MECHANICAL EQUIPMENT AND SYSTEMS FOR THE CONSTRUCTION PHASE OF NUCLEAR POWER PLANTS. Draft 3, Rev. 0. New York; American Society of Mechanical Engineers (1973). 27p. (ANSI-N45.2.8).

This standard provides requirements and guidelines for installation, inspection and testing activities that assure the quality of important mechanical parts of a nuclear power plant not covered by the ASME Boiler and Pressure Vessel Code, Section III, during construction. These parts include those mechanical systems and components whose satisfactory performance is required: for the plant to operate reliably; to prevent accidents that could cause undue risk to the health and safety of the public; or to mitigate the consequences of such accidents if they were to occur. The requirements of this standard deal with the protection and control necessary to assure that the requisite quality of those important parts of the plant are preserved from the time items are removed from storage or receiving ultil they are incorporated into the plant up to but not including fuel loading for PWR plants and the completion of cold functional testing for BWR and HTGR plants. (auth)

4669 SUPPLEMENTARY QUALITY ASSURANCE REQUIREMENTS FOR INSTALLATION, INSPECTION, AND TESTING OF STRUCTURAL CONCRETE AND STRUCTURAL STEEL DURING THE CONSTRUCTION PHASE OF NUCLEAR POWER PLANTS. Draft 3, Rev. 0. New York; American Society of Mechanical Engineers (1973). 27p. (ANSI-N45.2.5).

This standard sets forth the requirements for installation, inspection, and testing of structural concrete and structural steel for nuclear power plant construction. It is intended for application to those structures from which satisfactory performance is required: (1) for the plant to operate reliably; (2) to prevent accidents that could cause undue risk to the health and safety of the public; (3) to mitigate the consequences of such accidents if they were to occur. Included are the following: (1) formwork; (2) steel reinforcement; (3) embedded items; (4) foundation preparation; (5) concrete; (6) structural steel. (auth)

GENERAL

Energy Utilization and Economics

Refer also to abstracts 2621, 2622, 2662, 2664, 2667, and 4763.

4670 (AEC-tr-7475) PROCESS FOR THE SIMULTANEOUS UTILIZATION OF GEOTHERMIC AND HYDRODYNAMIC ENERGY. Tavip, J. E. [nd]. Translation of Dispositiuo para el aprovechamiento simultaneo de la energia geotermica y la hidrodinamica. 7p. Dep. NTIS $3.00.

A process is described for the utilization of hydrodynamic energy produced by water falling through a pipe inserted deeply into the Earth's crust at a point where the high temperature will produce steam and is returned to the Earth surface through another pipe as steam. The waterfall created by this perforation is utilized by turbines suitable for the production of electric energy while the steam produced spurts from the surface of the Earth and can be used as a source of energy with multiple applications. (MCW)

4671 (BNL-18268) CENTRIFUGAL COAL FLASH HYDROGENATION IN A ROTATING FLUIDIZED BED REACTOR FOR A FULL-SIZED COAL LIQUEFACTION PLANT. Sheehan, T. V.; Steinberg, M.; Lee, Q. (Brookhaven National Lab., Upton, N. Y. (USA)). Aug 1973. 34p. Dep. NTIS $3.75.

A short contact time (<5 sec), high-temperature (>1000°F), high-pressure (>68 atm) reaction of hydrogen with coal favors high conversions to liquid hydrocarbons. The rotating fluidized bed is uniquely suited for obtaining these process conditions. The centrifugal force in the rotating bed maintains the coal particles in position against the high velocity stream of fluidizing hydrogen. The gravitational degree of freedom in a rotating fluidized bed yields extremely high heat transfer and reaction rates. One rotating fluidized bed unit 5 ft dia. × 2.5 high should be able to process 9,000 T/D of coal at 60% conversion efficiency for the production of the equivalent of 38,000 bbl/day of liquid hydrocarbon product. A design analysis of the centrifugal hydrogenation unit and the entire plant as well as a preliminary cost estimate is presented. (auth)

4672 (CONF-731026-2) DIELECTRICS FOR SUPERCONDUCTING SYSTEMS. Gauster, W. F.; Kernohan, R. H.; Long, H. M.; Schwenterly, S. W. (Oak Ridge National Lab., Tenn. (USA)). 1973. 15p. Dep. NTIS $3.00.

From conference on electrical insulation and dielectric phenomena; Varennes Quebec, Canada (29 Oct 1973).

An investigation of the dielectric properties of fluids and solids for use in superconducting systems is underway at the Oak Ridge National Laboratory as part of the AEC program in superconducting power transmission. The investigation initially will encompass ac and dc breakdown and pre-breakdown phenomena in liquid helium and in a variety of solids in liquid helium. Extension to impulse measurements is expected in the near future. A prime objective of the investigation is to determine scaling laws applicable to various models of superconducting cables and other cryogenic apparatus. Experimental facilities were set up for ac testing with a series resonant transformer to 700-kV rms and for dc testing to 600 kV. A high-voltage cryostat was designed for service to 1000 kV with provision for optical as well as electrical recording of both breakdown and pre-breakdown phenomena. Other apparatus for testing to lower voltages is also available. Instrumentation for partial-discharge measurements by multichannel pulse-height analysis, high-speed oscilloscope, and bridge detection is available. The influence of electrode surfaces and impurities as well as pressure and temperature on the dielectric properties of liquid helium will be determined. The behavior at large gaps is of particular interest. Breakdown and surface flashover of bulk and laminated solids in liquid helium and in vacuum at liquid helium temperatures are to be included in the investigations. (auth)

4673 (CONF-731027-1) REMARKS BY GEORGE FUMICH, Jr., ACTING DIRECTOR. Fumich, G. Jr. (Office of Coal Research, Washington, D. C. (USA)). 1973. 14p.

Progress is reported by the Office of Coal Research in the USA on the cooperation of associations, industries or industry groups, and universities. The sharing of the funding has enhanced the program. The technologies discussed include liquid fuel from coal, high- and low-Btu gas from coal, and improved direct combustion systems. Advanced coal technologies include plans to investigate bottoming cycle power generation as well as work on a molten salt combustion/gasification system. Magnetohydrodynamics is an advanced method applicable to generating electricity from coal. (MCW)

4674 (CONF-731027-2) REPORT ON COAL RESEARCH IN THE UNITED STATES. (National Coal Association (USA)). 1973. 21p.

The research on coal involves the government, private and public associations, private non-profit groups, and universities. The research programs underway for each agency are discussed. The mining of coal and the problems connected with the procedures are summarized. Gasification and liquefaction are stressed. Combined power cycles, binary cycles, and open-cycle MHD systems fired by clean, low-Btu coal gas provide for near-term solution to the energy crisis. OCR's power generation objectives include development of low-Btu gasification systems, MHD central station systems, and fluidized bed combustion systems. Funding for environmental control studies is delineated. (MCW)

4675 (CONF-731027-3) REPORT ON COAL RESEARCH IN WESTERN EUROPE. (European Coal Producers Association, Brussels (Belgium)). 1973. 35p.

From international coal research conference; Washington, District of Columbia, USA (16 Oct 1973).

The report covers information from the West European countries on the organization and financing of technical research and on the major current and envisaged research projects of coal. The report covers organization of coal research in the West European countries of Belgium, France, Federal German Republic, United Kingdom, and the European Communities; current research in 1972, expenditure on current research, and focal points of envisaged research for the future; and the financing of coal research. Appendix 1 includes a systematic catalogue of research sectors and Appendix 2 is a list of research establishments shown separately for each country. (MCW)

4676 (CONF-731027-4) REPORT ON STATUS OF FEDERALLY SUPPORTED COAL RESEARCH IN CANADA. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1973. 8p.

Predictions indicate increased coal research and development are necessary because coal production will have to increase more than four-fold (to 100 million tons per year) by the end of this century to fulfill its share of Canada's energy needs. Federal participation in coal research may continue to be more extensive than for other fossil fuels because current poor levels of return on investment in the coal industry curtail funds available for research activities. The Federal government currently supports research, technical advice, problem-solving studies, and laboratory services that cannot be carried out by other agencies. (MCW)

4677 (HIT-498) ELECTRICAL POWER SUPPLY AND DEMAND FORECASTS FOR THE UNITED STATES THROUGH 2050. (Hittman Associates, Inc., Columbia, Md. (USA)). Feb 1972. 55p. (PB-209-266).

The historical growth of the demand for electrical power, the trends in selection of power plant fuels by geographic distribution, projections of power demand growth into the twenty-first century, and the potential impacts on national air quality resulting from the various alternatives of fuel usage are explored. In particular, power plants scheduled for construction from mid-1971 onward are surveyed to provide a basis for estimating the impact of national emission standards for sulfur dioxide on the electrical generating industry. Total installed power capacity will increase from about 320,000 MW in 1970 to about 1,000,000 MW in 1990, about 1,500,000 in 2000, and 5,200,000 in 2050. Fossil fuels supplied about 83% of utility power in 1970. Fossil-fuel use will decrease to about 50% in 2000 and to about 11% in 2050, while nuclear power will increase from the present 3% to about 45% in 2000 and to about 88% in 2050. Barring any major unforeseen developments, such as cataclysm, catastrophe, or revolutionary scientific discovery, there appears to be reasonable certainty that national electrical power demands and supplies will approximate the growth curves delineated. (auth)

4678 (HIT-499) STUDY OF THE FUTURE SUPPLY OF LOW SULFUR OIL FOR ELECTRICAL UTILITIES. (Hittman Associates, Inc., Columbia, Md. (USA)). Feb 1972. 76p. (PB-209-257).

The factors influencing the supply and demand of low-sulfur residual oil were studied. The demand for residual oil by all domestic markets including the utilities will increase from 2.25 million bbl/day in 1970 to 3.90 million bbl/day in 1980. Electrical utilities' share of the total demand will increase significantly in the 1970s from 0.64 million bbl/day to 2.24 million bbl/day. About 3.20 million bbl/day or 83 percent of the total demand for residual oil will be under Federal or local regulations by the year 1980.

Total residual supply is estimated to equal demand with only a minor increase in imports over the current import trend line. Low-sulfur residual, however, will not meet regulated demand without an intense effort beyond reasonable expectations. A large percentage of South American residual must be desulfurized. Significant domestic residual desulfurization will also be necessary. (auth)

4679 (LA-5271-PR) USAEC-DAT dc SUPERCONDUCTING POWER TRANSMISSION LINE PROJECT AT LASL. Progress Report, November 1, 1972–March 1, 1973. Bartlett, R. J.; Hoffer, J. K.; Keller, W. E.; Kerr, E. C.; McDonald, T. E.; Taylor, R. D.; Trela, W. J.; Giorgi, A. L.; Dickinson, J. M. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1973. Contract W-7405-eng-36. 76p. Dep. NTIS $6.00.

The aims of the SPTL project include a demonstration that incorporation of dc superconducting transmission lines into the present US electrical utility power system is not only feasible but would lead to capital and operating economies compared with either conventional cable systems or superconducting ac lines, whenever large blocks of power are to be transmitted over long distances. The impact on the environment is minimal. The demonstration model is a line 1000 km long capable of carrying 5 GW of power, the type useful for carrying power from the Four Corners production complex to large urban areas in Phoenix, San Diego, or Los Angeles. The experiment includes data on superconducting samples, critical current measurements, test bed parameters, and power engineering studies. Experimental progress and planning are reported. (MCW)

4680 (LA-5361-PR) USAEC-DAT dc SUPERCONDUCTING POWER TRANSMISSION LINE PROJECT AT LASL. Progress Report, March 1–June 30, 1973. Keller, W. E.; Taylor, R. D. (Comps.) (Los Alamos Scientific Lab., N. Mex.). Aug 1973. Contract W-7405-eng-36. 24p. Dep. NTIS $4.00.

Progress is described in the areas of superconducting materials development, fabrication, and characterization; superconducting cable test-bed construction and instrumentation; and specifications for electrical power system studies incorporating dc superconducting transmission lines. (auth)

4681 (LA-tr-73-40) AND WHAT IF WE WERE TO SWITCH TO HYDROGEN? Medvedev, Yu.; Muslin, E. Translated by A. D. Cernicek (Los Alamos Scientific Lab., NM), from Izobret. Ratsion.; No. 318, 40-44(1973). 25p. Dep. NTIS $3.25.

A depletion of fossil fuel is predicted and, long before that, a dangerous pollution of the environment by its combustion products is approaching at a precipitous rate. As one possible solution to these serious problems it has been proposed to use ordinary water as a fuel source from which to derive hydrogen. The production of hydrogen by the reactions of the Mark-1 process and the process with iron-carbon catalyzers is discussed. The pipelines and transport of hydrogen with its applications to fuel sources or everyday life are discussed. An attempt to invent an automobile that uses hydrogen or its derivatives as fuel continues. Hydrogen yeast synthesizes proteins, fats, and vitamins that make an excellent fodder for cattle. It is predicted that it will be possible to establish a powerful food chain depending neither on agriculture nor on oil reserves and based only on atomic energy. Scientists at NASA have been trying, with the aid of "hydrogen yeast", to obtain food from carbon dioxide, mineral salts, and hydrogen obtained with electrolysis of water by current from solar batteries. The same hydrogen and oxygen could serve as an energy source for fuel cells. (MCW)

4682 (NP-19837) ELECTRICITY: THE CONVERSION INDUSTRY. Heal, N. B. (Electricity Commission of New South Wales, Sydney (Australia)). 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

Planning of future electric power supplies is considered with specific reference to Australia. Topics covered include fuel reserves, fuel costs, electricity supply today, planning future supplies, energy transport, and the effect of changes on the consumer. Coal, uranium, and possibly natural gas coal reserves are clearly adequate to provide a supply of fuel at reasonable costs for power generation for well into the next century. In comparison with uranium and coal, known reserves of crude oil and natural gas in Australia are relatively small. (MCW)

4683 (PB-208550) SOLAR ENERGY IN DEVELOPING COUNTRIES: PERSPECTIVES AND PROSPECTS. (National Academy of Sciences–National Research Council, Washington, D. C. (USA)). Mar 1972. 59p. Dep. NTIS $5.00.

The present state of development of processes for utilization of solar energy, applications now being made of this energy resource, and possible future developments in solar processes in the context of energy needs in developing countries were studied by an ad hoc panel of the Board on Science and Technology for International Development. The desirability of establishing an International Solar Energy Institute in North Africa was considered. General conclusions are that: solar energy is an energy resource widely available in areas with energy needs in developing countries; useful applications of solar energy are now being made; other applications are in various stages of experimental development; knowledge of energy needs in developing countries is inadequate and must be improved; and research and development programs to meet these needs should include, but not be limited to, consideration of solar energy. The panel concludes that solar energy is a resource that has the capability to meet energy needs substantially beyond the applications now being made, and that this potential can be realized only with further research and development. (MCW)

4684 (SLA-73-946) FRACTURE OF COAL AND OIL SHALE FOR IN-SITU PROCESSING OR REMOTE REMOVAL: A PROPOSAL SUPPORT DOCUMENT. Tyler, L. D.; Weart, W. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1973. Contract AT(29-1)-789. 17p. Dep. NTIS $3.00.

A detailed description is given of work proposed for the fracturing of coal and oil shale formations in-situ. The proposal sets forth the concept of using the synergistic effects of a combination of hydraulic and explosive techniques to fracture these formations in a controlled manner. (auth)

4685 (UCID-16298) NEW PROCESS FOR THERMOCHEMICAL DECOMPOSITION OF WATER USING PROCESS HEAT TO PRODUCE HYDROGEN. Ramsey, W. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Jun 1973. Contract W-7405-Eng-48. 17p. Dep. NTIS $3.00.

Thermochemical estimates and experimental evidence lead to the conclusion that a lower-temperature cycle for hydrogen production from water is possible. Critical experiments must confirm the conclusion and heat flow, corrosion and economic questions need to be answered. One of the determining economic influences will be the mercury inventory required. This depends on quantities not yet measured. (22 references.) (MCW)

4686 CALIFORNIA'S ELECTRICITY QUANDARY. I. Estimating Future Demand. Mooz, W. E.; Mow, C. C. R-1084 NSF/CSRA. Santa Monica, CA; Rand Corporation (1972). 71p. $3.00.

Results are given for a study made by the Rand Energy Program that is focused on the underlying cause of the conflict between energy and the environment. Estimates were prepared of future demands for electricity in California for several alternative futures that include a base case, a case with price increases, low-growth case with price increases, low-growth case with constant prices, and high-growth case with constant prices. These estimates are intended to be used by the Resources Agency, in conjunction with other projections by the California Public Utilities Commission and the individual utilities, to aid in the preparation of a Twenty Year Power Plant Siting Plan for California. The methods used will be available to the Resources Agency for future revisions of the results as new information develops. (MCW)

4687 CALIFORNIA'S ELECTRICITY QUANDARY. II. Planning for Power Plant Siting. Ball, R. H.; Salter, R. G.; Dole, S.; Frederich, B.; Hammer, M.; Mooz, W. E.; Papetti, R.; Richards, G. R-1115-RF/CSA. Santa Monica, CA; Rand Corporation (1972). 114p. $4.00.

The summary is a study on the problem of the growing conflict between energy needs and environmental protection in California by the Committee on Planning and Land Use of the California State Assembly. The contract from the assembly was augmented by an existing grant for energy studies from the Rockefeller Foundation. An examination and evaluation of the alternative siting options for power plants was made in order to define the criteria and methods useful to a state siting agency in the site-selection process. The legislature was also interested in a discussion of the need for a power plant siting agency; the critical issues in establishing effective policy in this field; and the alternative structures, functions, and procedures for a siting agency. (MCW)

4688 CALIFORNIA'S ELECTRICITY QUANDARY. III. Slowing the Growth Rate. Doctor, R. D.; Anderson, K. P.; Berman, M. B.; Dole, S. H.; Hammer, M. J.; McClure, P. T.; Smith, C. B. R-1116-NSF/CSA. Santa Monica, CA; Rand Corporation (1972). 158p. $4.00.

The summary is a study on the problem of the growing conflict between energy needs and environmental protection in California by the Committee on Planning and Land Use of the California State Assembly. The contract from the Assembly was augmented by an additional grant received earlier from the National Science Foundation for energy studies. The study revealed a need for new state policies that would slow the growth of electricity demand, an estimate of the potential effectiveness of policies designed to slow the growth rate, and an evaluation of the potentially important side effects of slowed electricity growth. (MCW)

4689 ENERGY, TECHNOLOGY, AND SOLARCHITECTURE. Hay, H. R. (Sky Therm Processes and Engineering, Los Angeles). Mech. Eng.; 95: No. 11, 18-22(Nov 1973).

An evaluation of a diurnal energy air conditioning system funded by the U. S. Department of Housing and Urban Development pertains to a "sky therm" house to be built in California. Solar architecture is compatible with the objectives of conservation groups in energy and in land use. It can reduce by 70% the residential power needs in most of the Southwest through buildings whose materials, structural elements, landscaping, and operation are designed to take maximum advantage of night-sky cooling and direct use of solar energy for space and water heating. All aspects of the project are described. (MCW)

4690 COAL GASIFICATION: THE NEW ENERGY SOURCE. Williams, J. E.; Dressel, J. H. (Stearns-Roger Inc., Denver). CIM (Can. Mining Met.) Bull.; 66: No. 730, 72-77(Feb 1973).

This review of coal gasification describes processes available today and in the future. Winkler, Koppers-Totzek, and Lurgi processes are briefly described. The Lurgi Process has been applied extensively for practically all of the first-generation projects. Some new processes include Bituminous Coal Research's BIGAS Process, Consolidation Coal's "CO_2 Acceptor" Process, and the Institute of Gas Technology's "HYGAS" Process. All these processes use fine coal and employ fluid beds in which the coal particles are either suspended or carried along by the gases in the gasifier. They do not have moving parts inside the gasifier. The processes may allow scale-up to much larger sizes than the Lurgi gasifier and possibly reduce the capital cost for gasifiers. Initial engineering progress for commercial plants is being made on low-BTU gas projects for the power industry and high-BTU gas projects to produce synthetic natural gas. An illustration is described to show the size of the mine and coal preparation plant necessary to support a 250-MMscf/D gasification plant and to show some of the difficulties encountered in the materials handling for a commercial gasification plant. (MCW)

Law

Refer also to abstracts 2658, 2659, 2661, and 2665.

4691 (FRNC-CONF-85) COOPERATION IN THE NUCLEAR REACTOR DOMAIN. Industrial Property Problems. Lepetre, J. P. (Brevatome, 75 - Paris (France)). 1973. 3p. (In French). (CONF-730341-7). Dep. NTIS (U. S. Sales Only) $3.75.

From international cooperation in reactor material and nuclear fuels conference; Paris, France (2 Mar 1973).

The necessity of international cooperation in the field of nuclear energy is discussed. The dispositions of the Euratom treaty with regard to industrial property are analyzed in terms of the legislation concerning competition contained in the EEC treaty. The interpretation given by the competent institutions of the European Community (Commission, Cabinet and Court) are presented. (FR)

4692 NEPA'S IMPACT STATEMENT IN THE FEDERAL COURTS: A CASE STUDY OF NRDC VS MORTON. Lukey, J. A. Environ. Aff.; 2: No. 4, 807-826(Spr 1973).

To date, the National Environmental Policy Act of 1969 (NEPA), has provided an effective forum in the Federal courts for environmentalists. Besides giving conservation groups standing to bring suits, the Act as interpreted by the courts forces Government agencies to study and consider the effects of their activities on the environment. The courts have the power of judicial review of Government compliance with NEPA as two stages: first, where challenged by an individual or organization with standing, the courts have made the substantive determination as to whether or not a particular project falls within the meaning of the Act; and second, the courts have determined whether the Federal agency has adequately fulfilled the procedural requirements of the Act. Most litigation in both areas has concerned the impact statement. NRDC v. Morton is cited as an excellent example of the use of that procedural requirement as an environmentalist's tool. Guidelines were enumerated concerning the scope of alternative provisions to be included in the impact statement. Recommendations for judicial review are included. (MCG)

Management

4693 (NP-19886) TWENTY-FIRST ANNUAL REPORT, 1972–1973. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). [nd]. 128p. Dep. NTIS (U.S. Sales Only) $8.50.

A review of world and Australian nuclear power developments, uranium supply, demand and processing, public health and the environment, and radioisotopes and radiation is presented. Staff research activities and publications are given as well as international and general matters concerning A.A.E.C. Accounts are itemized. (AT)

4694 (Y-DE-50) PROGRAMMING MANAGEMENT IN THE BUSINESS MANAGEMENT SYSTEMS ENVIRONMENT. Tannert, R. A. (Oak Ridge Y-12 Plant, Tenn. (USA)). [nd]. Contract W-7405-eng-26. 21p. (CONF-731023-2). Dep. NTIS $3.25.

From ninth AESOP meeting; San Francisco, California, USA (1 Oct 1973).

The role of planning is emphasized as it embraces three areas of activity and performance necessary for effective management, namely: (1) the need for direct results, (2) commitment to building of values and their reaffirmation (applied directly to the data processing organization), and (3) building and developing people for tomorrow. The author then relates his approach to and understanding of the job of programming management, personnel aspects relating to management of the programming staff, organization of the programming department, and estimation and control of programming objects. In the conclusions two points are emphasized: (1) the professional manager should have a deep interest in his company and not just data-processing problems, and (2) being a program manager means you manage people, not programs. (LMT)

Mathematics and Computers

4695 (CEA-CONF-2298) APPARATUS FOR ANALYSIS OF TRANSIENTS: NUMERIC MEMORY UNIT UMN 1024. Berthier, D. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 11 Jan 1973. 18p. (In French). (CONF-721147-1). Dep. NTIS (U. S. Sales Only) $3.00.

From seminar of the group of users of signal treatment; Grenoble, France (20 Nov 1972).

4696 (COO-1469-231) FROG: DESIGN AND SIMULATION STUDY OF A MECHANISM WHICH LEARNS SELF-PRESERVATIVE REACTIONS TO ITS ENVIRONMENT. Bose, D. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Aug 1973. Contract AT(11-1)-1469. 120p. (UIUCDCS-R-73-588). Dep. NTIS $8.00.

Thesis.

FROG is the simulation of mechanism which learns to discriminate between various classes of stimuli. The stimuli are some bugs (good and bad tasting) and predators. Each class of stimulus is characterized by the particular values of a set of visual characteristics. FROG acts like an adaptive filter. The visual data, interpreted through the filter, and a few somatic signals, which measures the requirements of FROG for feed and rest, are combined to decide upon one of the following list of actions: (1) feed, (2) rest, (3) flee. (auth)

4697 (COO-2200-4) PERIODIC BAND MATRIX SOLUTION. Gibbons, W. P. (Northwestern Univ., Evanston, Ill. (USA)). 30 Sep 1973. Contract AT(11-1)-2200. 9p. Dep. NTIS $3.00.

A routine, BCMAT, is presented for solving a system of linear algebraic equations with a periodic band matrix. (DLC)

4698 (JAERI-M-5133) COMPUTER PROGRAM LSQKKD FOR THE NONLINEAR LEAST-SQUARES METHOD. Koyama, K.; Sasamoto, N. (Japan Atomic Energy Research Inst., Tokyo). Feb 1973. 11p. (In Japanese). NTIS (U. S. Sales Only).

Computer program "LSQKKD" for the nonlinear least-squares method has been prepared, which is in the form of subroutine to be widely applicable with other programs. It is necessary, however, to define the fitting function and its first partial differentiation with respect to the fitting parameters. With the program the parameters and their errors can be obtained with or without the upper and/or lower limits. The number of parameters dealt with in the program is a maximum of 53, the core memory being about 25 K words. (auth)

4699 (KFK-1712) PLIM: A VIRTUAL PL/1-MACHINE. Rupp, M.; Nehmer, J.; Fleck, G.; Hilse, D.; Friehmelt, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Datenverarbeitung in der Technik). Jul 1973. 97p. (In German). Dep. NTIS (U. S. Sales Only) $7.00.

PLIM is a simulation facility developed for the analysis of the dynamic behavior of operating system software. (auth)

4700 (KFK-EXT-13/73-1) PROCESS COMPUTER CATALOGUE OF SOME SELECTED SYSTEMS. Herbstreith, H.; Kossman, P.; Merkel, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Datenverarbeitung in der Technik). Jun 1973. 55p. (In German). Dep. NTIS (U. S. Sales Only) $4.75.

A catalog with the most important characteristics of 19 process computers presently distributed over the German market is presented. Its purpose is to provide a decision making tool for the selection of process computer systems for research. (auth)

4701 (LA-5407-MS) METHOD OF SAMPLING CERTAIN PROBABILITY DENSITIES WITHOUT INVERSION OF THEIR DISTRIBUTION FUNCTIONS. Everett, C. J.; Cashwell, E. D.; Turner, G. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1973. Contract W-7405-eng-36. 4p. Dep. NTIS $4.00.

A Monte Carlo device is described which bypasses the inversion $x = p^{-1}(r)$ involved in directly sampling the distribution P(x) of a stochastic variable x with given density p(x). The method is practical for all linear and a broad class of quadratic densities. (auth)

4702 (LA-5410-MS) ANSIFT: AN ANSI STANDARD FORTRAN SIFTING PROGRAM. Cox, C. W. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 15p. Dep. NTIS $4.00.

ANSIFT is used to look for and change or flag common nonstandard usages in CDC FORTRAN source decks. The program itself is written in standard FORTRAN to make it more adaptable for use on other computers. (auth)

4703 (NASA-SP-5966(1)) COMPUTER PROGRAMS: MECHANICAL AND STRUCTURAL DESIGN CRITERIA. A COMPILATION. (National Aeronautics and Space Administration, Washington, D. C. (USA)). [nd]. 15p. Dep. NTIS $4.00.

This publication is divided into two sections. Section one presents some computerized design criteria in the mechanical field and is largely devoted to turbomachinery and the constraints imposed by very high rotational speeds. The second section covers a variety of computerized design criteria that should be of interest to designers of structures and structural components. (DLC)

4704 (RL-73-102) DIRECT CALCULATION OF MAGNETIC FIELDS IN THE PRESENCE OF IRON, AS APPLIED TO THE COMPUTER PROGRAM GFUN. Turner, L. R. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Aug 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

Methods of solution of the integral equations used in the GFUN program in two-dimensional, three-dimensional, and axisymmetric versions are described. (auth)

4705 (SGAE-2155) CAMAC MODULE FOR A FORSTER TERMINAL READER (SINGLE CARD READER) CCR-1. Schwabach, H.; Gratcl, P. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Elektronikinstitut). Aug 1973. 20p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

The application of processors for data acquisition and/or control problems often makes data inputs into the computer necessary (product reference numbers, control parameters, etc.). These data are changed very rarely but have to be put into the computer more often because of technical reasons. To avoid errors when using a keyboard for this purpose, cards are used. The CAMAC module CCR-I was developed for a FORSTER single card reader. (auth)

4706 (SLA-73-5515) MICROCIRCUITS: IR STUDIES ENHANCED BY AN INTERACTIVE MINICOMPUTER SYSTEM. Stiefeld, B. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 9p. (CONF-731103-1). Dep. NTIS $3.00.

From IEEE northeast electronics research and engineering meeting; Boston, Massachusetts, USA (6 Nov 1973).

The determination of temperature across the surface of a microcircuit is frequently of importance during the design phases of a project. Noncontact IR techniques are a natural choice to perform this operation. Minicomputer-based techniques are described that minimize the problems of emissivity variation, and radiance-to-temperature conversion that are associated with IR-scanning techniques. Data is acquired and displayed using interactive procedures which are intended to enhance the ability of the concerned designers both to obtain the exact data desired and to display it in the most desirable manner. (auth)

4707 (SLL-73-271) USER'S GUIDE FOR DIGITAL (DIGITIZED INPUT TO ART LAYOUT). Quock, H.; Affeldt, B. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1973. Contract AT(29-1)-789. 48p. Dep. NTIS $4.50.

The use of DIGITAL, a FORTRAN program that outputs numerical control information for printed circuit masters is explained. The input for this program is created with the aid of an X and Y coordinate digitizer. A sample problem is included. (auth)

Miscellaneous

4708 (BLG-482) THERMODYNAMIC PROPERTIES OF ORDINARY WATER IN THE REGION OF THE CRITICAL POINT. de West-Meerbeeck, A. B. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Dec 1971. 26p. (In French). Dep. NTIS (U. S. Sales Only) $3.50.

A literature search of the most recent bibliography (1968 Tokyo Conference) leads to an appreciation of the present state of knowledge of measurement, of pressure, temperature, specific volume, and the thermodynamic properties of water near the critical point. The utilization of the virial force theorem enables the equation of state to be precisely stated in the critical region. A comparison is made of the most recent measurements and the formulas utilized for specific heat at constant volume or dynamic viscosity and for the thermal conductivity in the region near the critical point. (tr-auth)

4709 (BNL-18274) NEUTRON SCATTERING STUDIES OF THE E. COLI RIBOSOME. Moore, P. B.; Engelman, D. M.; Schoenborn, B. P. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 28p. (CONF-730947-1). Dep. NTIS $3.50.

From conference on the structure of the ribosome; Cold Spring Harbor, New York, USA (4 Sep 1973).

About a year ago it was suggested that the quaternary structure of the ribosome could be studied by the technique of low angle scattering of thermal neutrons in solution (Engelman and Moore, Proc. Nat. Acad. Sci., Wash., 69: 1997 (1972)). Progress made over the last year towards bringing this proposal to fruition is reported here. In so doing, some recent results on the global distribution of RNA and protein in the 50S ribosomal subunit of E. coli are discussed. (auth)

4710 (BNL-50397) FLAX POND: AN ESTUARINE MARSH. Woodwell, G. M.; Pecan, E. V. (Brookhaven National Lab., Upton, N. Y. (USA)). Jun 1973. Contract AT(30-1)-16. 10p. Dep. NTIS $4.00.

Flax Pond is a 50-hectare estuarine marsh on the north shore of Long Island with a single channel connection to Long Island Sound. It is the site of intensive research focused primarily on the exchange of nutrients with the Sound. At high tide the area of water is $\sim$574,000 m^2; volume is about 880,000 m^3. Salinity averages 26‰. The mean tidal range is about 1.8 meters. The tidal pattern varies little over the year; the duration of ebb tide is usually two hours longer than that of the flood due to a sill in the entrance of the channel. Principal vegetation is Spartina alterniflora. Details of the pond's structure and function are rapidly being accumulated to the point where this estuarine marsh is one of the most thoroughly known such sites in the world. This report offers some of the background data available now to students of Flax Pond. (auth)

4711 (BNWL-tr-89) METHODS DEVELOPED TO DETERMINE THE TENDENCY FOR DIFFERENT TYPES OF WELD CRACKING IN AUSTENITIC STAINLESS STEELS. Leclou, A.; Soulat, P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1972. Translated by L. Appleby (Battelle Pacific Northwest Labs., Richland WA), from a French paper. 50p. Dep. NTIS $4.50.

Tests on austenitic stainless steels have been undertaken in order to evaluate their resistance to types of cracking such as hot cracking during welding of the heat-affected zone and cracking in relaxation of the heat-affected zone of a welded assembly during a relaxation treatment or during stay at service temperature. A Varestraint test is described which offers good possibilities for testing the tendency of the metals to hot cracking. For a complete view of the aptitude of the material to crack, three criteria must be considered: the total crack length, the elongation beyond which cracking occurs, and the maximum length of the cracks. Tentative predictions on the cracking behavior as a function of the chemical composition are delicate and uncertain; only a correlation with the ferrite proportion has been established. Comparison with an industrial experience shows the validity of predictions made with the Varestraint test, which thus seems a test well adapted for estimating the susceptibilities of the metals to hot cracking. Study of cracking in relaxation by means of flanged specimens revealed that large cracks are only observed for stabilized compositions, certain of these, however, behaving satisfactorily. A hold at 600°C for 1500 h may cause the beginning of cracking to appear, thus validating the short-term tests done at 750°C. (auth)

4712 (BNWL-tr-90) VASCULAR REGULATION MECHANISMS ON THE TESTES. Hundeiker, M. Translated from Arch. Dermatol. Forsch.; 245: 229-244(1972). 18p. Dep. NTIS $3.00

4713 (BNWL-tr-93) USE OF THE DERIVATOGRAPH FOR THE SIMULTANEOUS DILATOMETRIC AND DIFFER-

ENTIAL THERMAL ANALYSES OF GLASSES. Heide, K.; Haft, R.; Paulik, J.; Paulik, F. Translated by B. G. Russell from J. Therm. Anal.; 4: 83-87(1972). 6p. Dep. NTIS $3.00.

Simultaneous DTA and dilatometric measurements were made and the derivatives of the dilatometric curves were taken for three glasses by means of a derivatograph. Glass blocks were used as test pieces with a boring for the thermoelement. A maximum was observed in the rate of length change, which can be explained by overheating phenomena. A comparison with DTA curves of glass powders published by Yamamoto showed that the break points in the DTA curves of glass blocks do not coincide with the Tg points, but under identical conditions they can serve for the rapid characterization of the transformation range. (auth)

4714 (BNWL-tr-101) CHEMICAL DISINTEGRATION OF SILICATES. Correns, C. W. Translated From Naturwissenschaften; 28: No. 24, 369-376(1940). 19p. Dep. NTIS $3.00.

The processes of silicate chemical decomposition and formation of new decomposition minerals were studied by a combination of laboratory work and nature observation using microscopy and x-ray techniques. It was found that silicates dissolve in water into ions, and that with the hydrogen ion concentrations occurring in nature there remains no residue or even a "residual lattice". Residual layers of amorphous silica appear only with the already very strong acid degree pH = 0. Results of experimental investigations agree with findings in nature. (JRD)

4715 (CALT-822-53) MAGNETIC AND ELECTRICAL PROPERTIES OF AMORPHOUS Pd–Co–P ALLOYS. Marzwell, N. I. (California Inst. of Tech., Pasadena (USA). W. M. Keck Lab. of Engineering Materials). Sep 1973. Contract AT(04-3)-822. 42p. Dep. NTIS $4.25.

The magnetic properties of Pd–Co–P alloys show that they are ferromagnetic with a Curie temperature between 272 and 399°K as the cobalt concentration increases from 15 to 50 at. %. Below 20 at. % Co the short-range exchange interactions which produce the ferromagnetism are unable to establish a long-range magnetic order and a peak in the magnetization shows up at the lowest temperature range under an applied field of 6.0 KOe. The electric resistivity measurements were performed from liquid helium temperature up to the vicinity of the melting point (900°K). The electrical resistivity of Pd–Co–P shows the coexistence of a Kondo-like minimum with ferromagnetism. The minimum becomes less important as the transition metal concentration increases and the coefficients of ln T and T^2 become smaller and strongly temperature dependent. The spin ordering in these kinds of alloys can be simulated as the ordering due to an applied external field or as an increase in internal fields, due to an increase in transition metal concentration. The negative magnetoresistivity is a strong indication of the existence of localized moment. (auth)

4716 (CEA-CONF-2287) IS INFECTIVITY RELATED TO THE INTEGRITY OF THE VIRUS OF MURINE MAMMARY TUMOR. Viala, C.; Gorka. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1972. 10p. (In French). (CONF-720691-3). Dep. NTIS (U. S. Sales Only) $3.00.

From 7th international conference on mammary tumors; Saint-Pierre-de-Chartreuse, France (12 Jun 1972).

Dealing with mammary tumors of the PS strain of mice, efforts to sediment the biological activity of cell-free extract supernatants are reported. (auth)

4717 (CEA-CONF-2288) CELL LINE ESTABLISHED STARTING WITH A MOUSE MAMMARY TUMOR. Effect of the Addition of Hormones. Mouriquand, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1972. 13p. (In French). (CONF-720691-2). Dep. NTIS (U. S. Sales Only) $3.00.

From 7th international conference on mammary tumors; Saint-Pierre-de-Chartreuse, France (12 Jun 1972).

The PS-MT cell line was defined (18th passage); isolated from a pool of mammary tumors of the PS strain of mice, it remained dormant for 6 months and then grew out very slowly. Subcultures were possible only after 19 months. The morphology is epithelial. After storage in liquid nitrogen in a medium containing 5% DMSO, the viability was approximately 80%. It was not possible to disclose the presence of mycoplasmas. With the standard insulin-containing medium, a few C-type particles were observed by electron-microscopic examination. The addition of hydrocortisone or prolactin, or both hormones together, increases slightly the production of C-type particles. If the secretory stimulating activity of hydrocortisone is maintained for one week before the addition of prolactin for another week, a large amount of A and B particles are found, mixed with C-type particles. They are present in large number in the pellets obtained from the tissue culture media. Five mammary tumors within 6 months were obtained in BALB/c females. Thus, the production of A- and B-type particles is hormone-dependent and requires the same sequence of hormones as the production of casein by mammary glands in organ cultures. (auth)

4718 (CISE-N-161) ELABORATION AND INTERPRETATION OF THE CARDIAC MAP. Dotti, D.; Ferrari, R.; Ricca, A. (Centro Informazioni Studi Esperienze, Milan (Italy)). Jun 1973. 31p. (In Italian). Dep. NTIS (U. S. Sales Only) $3.75.

4719 (CISE-N-162) OPTIMUM LAYOUT OF TWO-DIMENSIONAL ELEMENTS IN ARCHITECTURAL AND URBAN DESIGN. Casanova, M.; Tagliabue, G. (Centro Informazioni Studi Esperienze, Milan (Italy)). Jun 1973. 47p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.50.

Layout problems in computer-assisted architectural design are briefly presented. The basic problem is stated and most of the algorithms published in the scientific literature are evaluated; the CRAFT algorithm and its implementation on the IBM 1800 in the program CT73 are discussed by means of some examples. Extensions of CT73 are then presented, with reference particularly to its interactive use and to the introduction of distance constraints. (tr-auth)

4720 (CLM-R-125) NUMERICAL CALCULATIONS ON THE DYNAMICS OF TWO-DIMENSIONAL IDEAL FLUIDS. Christiansen, J. P.; Peckover, R. S. (UKAEA Research Group, Abingdon. Culham Lab.). Jul 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

Although it is necessary that a liquid have viscosity in order to generate shear layers and streets of vortices, the development of such hydrodynamic flows can be reproduced in effectively inviscid systems. The report describes some work on the stability and nonlinear breakup of streets of vortices of finite extent, and on the interaction between two finite vortices. (auth)

4721 (CNEA-347) AUTOMATIC STRAIN INDICATOR. Esparza, D. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 6p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

The mechanism that shows the whole deformation during experiments concerning plastic deformation, at a constant tension, or at the constant strain rate is described. All phases of the experiment can be related to a differential indicator of deformation; instantaneous velocity can be deduced. (tr-auth)

4722 (CONF-730423-2) PROSPECTS FOR NEW CITIES: HISTORICAL VIEW. Lee, E. S.; Ritchey, P. N. (Georgia Univ., Athens (USA); Oak Ridge Population Research Inst., Tenn. (USA)). 1973. 20p. Dep. NTIS $3.00.

From Southern Regional Science Association meetings; New Orleans, Louisiana, USA (26 Apr 1973).

Whether new cities, independent entities set away from already-existing large cities, are likely to develop without major efforts and without much different attitudes from those which have prevailed in the past is discussed. It is believed that, given the will, population can be redistributed. However, the survey of city formation and growth leads to the conclusion that new places are increasingly located within the shadow of the metropolis and, as they grow, they will coalesce into the megalopolitan mass. By and large the cities are old, they cluster together, and their very existence militates against the formation of any but satellites. To move against a trend of this magnitude is a Herculean task. (auth)

4723 (CONF-730653-1) HUMAN IMMUNE RESPONSE TO RAUSCHER LEUKEMIA VIRUS. Hersh, E. M.; Gutterman, J. U.; Mavligit, G.; Gschwind, C. R.; Hanna, M. G. Jr. (Texas Univ., Houston (USA); Anderson (M. D.) Hospital and Tumor Inst., Houston, Tex. (USA); Oak Ridge National Lab., Tenn. (USA)). [nd]. 22p. Dep. NTIS $3.25.

From conference on biochemical trends in human leukemia; Hamburg, F. R. Germany (20 Jun 1973).

4724 (CONF-730833-3) PHOTOIONIZATION AND FRAGMENTATION OF POLYATOMIC MOLECULES. Chupka, W. A. (Argonne National Lab., Ill. (USA)). 1973. 32p. Dep. NTIS $3.75.

From chemical spectroscopy and photochemistry in the vacuum ultraviolet conference; Valmorin, Quebec, Canada (5 Aug 1973).

The discussion of photoionization and fragmentation of polyatomic molecules covers experimental procedures, energy deposition, dissociation processes and the determination of thermochemical quantities, and diatomic and small and large polyatomic molecules. (JFP)

4725 (CONF-731104-6) MAGNETIC EXCITATIONS IN NICKEL AND IRON. Mook, H. A.; Lynn, J. W.; Nicklow, R. M. (Oak Ridge National Lab., Tenn. (USA)). 1973. 13p. Dep. NTIS $3.00.

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973).

The magnetic excitations in Ni and Fe may be discussed in terms of the generalized susceptibility $X(\vec{K},\omega)$. Calculations for $X(\vec{K},\omega)$ at low temperatures predict a spin wave mode that rises to intersect a Stoner band of excitations. Neutron-inelastic-scattering measurements were made that confirm this overall picture while providing details such as the spin-wave dispersion and the Stoner mode–spin wave intersection point. In addition, temperature dependent measurements show that the spin waves persist as well-defined excitations up to at least 2 T_c and that better calculations of the temperature dependence of $X(\vec{K},\omega)$ are needed to explain the neutron scattering results. (auth)

4726 (COO-2128-5) POSITRON LIFETIME MEASUREMENTS AS A NON-DESTRUCTIVE TECHNIQUE TO MONITOR FATIGUE DAMAGE. Progress Report. Byrne, J. G. (Utah Univ., Salt Lake City (USA). Div. of Materials Science and Engineering). Sep 1973. Contract AT(11-1)-2128. 42p. Dep. NTIS $4.25.

The critical parts (electronics in the base of the photomultipliers) of the electronics have been brought under temperature control of within ± 0.1°C thus minimizing drift problems. In data analysis a computer program is functioning in which there are no fixed experimental parameters. This permits much more accurate results. Samples of pure Ni and a Ni–66.5% Co alloy have been fatigued to failure. Positron lifetime and x-ray particle size were measured at various fatigue lives and transmission electron microscopy was performed after failure. Good correlation was found between the three techniques and it appears that positron lifetime can be used as an effective tool to study fatigue mechanisms. It is a more sensitive nondestructive measurement than is x-ray particle size. It has been established that grain boundaries make a distinct contribution to the positron lifetime. Positron lifetime increases with plastic tensile strain in a manner dependent on initial grain size and in a manner consistent with existing work hardening theories. There are indications that the positron lifetime may be sensitive to hydrogen embrittlement or hydrogen assisted cracking (HAC) in steels. Experiments to study lifetime changes during cyclic softening and cyclic hardening of AISI 4340 steel are beginning. (auth)

4727 (COO-2223-14) CORRELATIONS BETWEEN FATTY ACID DISTRIBUTION IN PHOSPHOLIPIDS AND THE TEMPERATURE DEPENDENCE OF MEMBRANE PHYSICAL STATE. Linden, C. D.; Keith, A. D.; Fox, C. F. (California Univ., Los Angeles (USA); Pennsylvania State Univ., University Park (USA). Dept. of Biophysics). 1973. 28p. Dep. NTIS $3.50.

4728 (COO-2269-3) HYDROXYUREA AND IN VIVO SYNCHRONIZATION OF PROLIFERATING CELLS: PROBLEMS AND PROMISES. Dethlefsen, L. A. (Utah Univ., Salt Lake City (USA). Dept. of Radiology). 1973. Contract AT(11-1)-2269. 25p. (CONF-731005-2). Dep. NTIS $3.25.

From 13th Hanford biology symposium on the cell cycle in malignancy and immunity; Richland, Washington, USA (1 Oct 1973).

Many reports have shown that hydroxyurea, in vivo, can cause partial synchronization of proliferating cells in both normal and malignant tissue. Theoretically, clinical use for such agents could be rewarding. This report reviews the murine data within the framework of two models as an aid in evaluating the practicality of cell synchronization in cancer therapy. (LMT)

4729 (COO-3008-1) RESEARCH ON SLOW ELECTRON COLLISION PROCESSES IN GASES. Final Report, September 15, 1970–December 31, 1972. Baldwin, G. C. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). [nd]. Contract AT(30-1)-4144. 17p. NTIS $3.00.

Research on low energy electron collisions in gases by the time-of-flight velocity selection technique included, as a preliminary to total cross section measurements, investigations of the statistical and systematic errors inherent in the technique. In particular, thermal transpiration and instrumental fluctuation errors in manometry were investigated, and the results embodied in computer programs for data reduction. The instrumental system was improved to permit extended periods of data accumulation without manual attention. Total cross section measurements in helium, made prior to, and in molecular nitrogen, made after the supporting work was completed, are reported. The total cross section of helium is found to be higher than reported in previous beam determinations. That of nitrogen is found to be structureless at low energies. (auth)

4730 (COO-3150-15) HIGH-FIELD RIGHI–LEDUC COEFFICIENT OF POTASSIUM. Newrock, R. S.; Maxfield, B. W. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). Aug 1973. 12p. Dep. NTIS $3.00.

The Righi-Leduc coefficient was measured in polycrystalline specimens of potassium and is found to agree with the free-electron value to within the experimental error of 5%. (auth)

4731 (COO-3151-26) MAGNETIC-FIELD INDUCED FAR-INFRARED TRANSMISSION IN BISMUTH. Blewitt, R. L.; Sievers, A. J. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). Jun 1973. Contract AT(11-1)-3151. 120p. Dep. NTIS $8.00.

High magnetic fields render the semimetal bismuth sufficiently transparent at far infrared frequencies to study effects not previously seen in reflection experiments. The frequency interval 10 to 400 cm^{-1} was explored at fields up to 100 kG using Fourier transform spectroscopic techniques and ^{3}He-cooled bolometer detectors, and samples were cooled to liquid helium temperatures. Transmission was observed in all three principal crystal directions when the magnetic field was sufficiently large to drive one or more sets of electrons into the extreme quantum limit. The reduced absorptivity at these fields results from a large reduction in the relaxation rate. (35 figures, 49 references) (DLC)

4732 (COO-3151-27) TEMPERATURE AND HYDROSTATIC PRESSURE DEPENDENCE OF THE U-CENTER AND THE FAR INFRARED PROPERTIES OF POLYAMINO ACIDS. Shotts, W. J. (Cornell Univ., Ithaca, N. Y. (USA). Materials Science Center). Aug 1973. 212p. Dep. NTIS $12.75.

Thesis.

The far infrared absorption properties of KBr, KCl, and NaCl crystals containing U-center impurities and of covalently bonded polyamino acids were investigated. (DLC)

4733 (COO-3151-28) LATTICE VIBRATIONS IN NON-CRYSTALLINE SOLIDS. Pohl, R. O.; Love, W. F.; Stephens, R. B. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). Aug 1973. Contract AT(11-1)-3151. 32p. Dep. NTIS $3.75.

The specific heat of noncrystalline solids differs from that predicted by the Debye model by amounts much larger than is known for crystalline solids. This deviation is most pronounced at temperatures below 1°K. Near 0.1°K, the experimental specific heat approaches a linear temperature dependence and is up to 30 times larger than predicted by the Debye model. This paper describes Brillouin scattering experiments, and also measurements of the thermal conductivity in thin glass fibers. This work is aimed at elucidating the nature of the excitations responsible for this large specific heat. It is concluded that Debye phonons have sufficiently long lifetimes to be considered as good normal modes in noncrystalline solids and also that these phonons are the main carriers of heat at low temperatures. (11 figures, 29 references) (auth)

4734 (COO-3153-91) MULTIPLE CRYSTAL HOLDER FOR ULTRASONIC MEASUREMENT. Chen, Y. C.; Martinson, R. H.; Ruoff, A. L. (Cornell Univ., Ithaca, N. Y. (USA)). 1972. 10p. Dep. NTIS $3.00.

4735 (COO-3153-94) IMPROVED ELECTRICAL LEADS FOR HIGH-PRESSURE SYSTEMS. Terry, R. E.; Ruoff, A. L. (Cornell Univ., Ithaca, N. Y. (USA)). 1972. 5p. Dep. NTIS $3.00.

Electrical connections from the interior of a pressure vessel to atmospheric pressure typically place many design constraints on high pressure experimentation. A simplified version of older techniques using the cone seal has proven itself repeatedly in both gas and liquid systems with high reliability and ease of fabrication. Previous cone sleeves were made of oil soaked pyrophyllite, ivory and bone as well as certain plastics. All of these sleeves were made by careful machining to very close tolerances. Such machining was a considerable challenge (as well as being time consuming) and is completely eliminated in the technique described here. (auth)

4736 (COO-3153-98) NEW ABSOLUTE HIGH-PRESSURE GAUGE. Ruoff, A. L.; Lincoln, R. C.; Chen, Y. C. (Cornell Univ., Ithaca, N. Y. (USA). Dept. of Materials Science and Engineering). 1972. 28p. Dep. NTIS $3.50.

A new absolute pressure measurement system based on the simultaneous measurement of length and ultrasonic transit times is described. The system was used to determine the transition pressure of pure mercury at 0°C at 7571.2 ± 1.6 bars. It is particularly advantageous to use a device for calibrating secondary gauges such as manganin gauges inasmuch as it gives a highly accurate measurement of nonlinearities in such secondary gages. The gage calibrated in the present study reaches a maximum deviation from linearity of 11.6 bars at a pressure midway between atmospheric pressure and the 0°C mercury melting pressure. (auth)

4737 (COO-3153-103) HIGH-PRESSURE CALIBRATION WITH A NEW ABSOLUTE PRESSURE GAUGE. Ruoff, A. L.; Lincoln, R. C.; Chen, Y. C. (Cornell Univ., Ithaca, N. Y. (USA)). Jan 1973. 7p. Dep. NTIS $3.00.

The simultaneous measurement of length and transit time of a specimen under pressure was used to develop a new way of determining absolute high pressure. The mercury freezing point at 0°C was determined with this new method at 7571.2 ± 1.6 bars. Accurate high-pressure calibration of secondary pressure gages such as manganin gages is possible with this method. The maximum deviation from linearity of the present gage studied is 11.6 ± 1 bars between atmospheric pressure and the mercury freezing point at 0°C. (auth)

4738 (COO-3153-104) ABSOLUTE LENGTH MEASUREMENT AT HIGH PRESSURE. Lincoln, P. C.; Ruoff, A. L. (Cornell Univ., Ithaca, N. Y. (USA). Dept. of Materials Science and Engineering). [nd]. Contract AT(11-1)-3153. 33p. Dep. NTIS $3.75.

A length-measurement system is described that can make absolute length-change measurements of a meter-long specimen within a pressure vessel (to pressures of 8 kbar) with a fractional error of 3×10^{-8} even when changes in length of 4 cm occur. Possible uses of such a system for measuring the volume thermal expansivity (at pressure) and the isothermal bulk modulus (at pressure) are described. Moreover, it is noted that, when this system is combined with an ultrasonic velocity measurement system, the adiabatic bulk modulus (at pressure) and Grüneisen parameter as a function of pressure can be directly determined and the absolute pressure itself can be measured. (auth)

4739 (COO-3161-16) COMPUTER STUDY OF A CLASSICAL QUADRUPOLE SOLID. Mandell, M. J. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). Aug 1973. 35p. Dep. NTIS $3.75.

The Monte Carlo method is applied to a system of thirty-two classical free rotors on an fcc lattice with toroidal boundary conditions. The particles interact via nearest-neighbor electric-quadrupole interactions, characterized by an energy $\Gamma = 6Q^2/25R^5$. A first-order phase transition is found at about $k_B T = 10\Gamma$. Results are given for energy, specific heat, correlations of the form $\langle Y_2^m(\hat{k})^* Y_2^n(\hat{k}) \rangle$, and various other quantities. Suggestions are made for further experimental and theoretical studies. (auth)

4740 (COO-3400-12) KINETICS OF HYPOCALCEMIA IN COWS FED HIGH OR LOW CALCIUM DIETS. Ramberg, C. F. Jr. (Pennsylvania Univ., Kennett Square (USA). School of Veterinary Medicine). 1972. 19p. (CONF-720858-1). Dep. NTIS $3.00.

From 8th world buiatrics congress conference; London, England, UK (Aug 1972).

Calcium removal from bone was suppressed and slow to increase following parturition in cows fed high calcium diets. In cows fed low calcium diets, calcium removal from bone was the dominant inflow and increases were observed almost immediately following the onset of lactation. Recovery from hypocalcemia which followed the cessation of a prolonged calcium infusion was slower in cows fed high calcium diets than in cows fed low calcium diets. Cows fed high calcium diets appear to become dependent upon continuous gastrointestinal absorption as the sole calcium inflow and this leads to a defective homeostatic response to hypocalcemic stimuli. (auth)

4741 (COO-3476-5) INVESTIGATION OF PLASTIC FLOW IN CONSTRAINED COPPER CRYSTALS. Berkowitz, B. J. (State Univ. of New York, Stony Brook (USA). Dept. of Materials Science). Jun 1973. Contract AT(11-1)-3476. 53p. Dep. NTIS $4.75.

Thesis.

Comparative studies of the changes in microstructure and micro-relaxation parameters were made between high-purity copper single crystals and identical single crystals which had a surface modification. The latter specimens had a fine-grain polycrystalline surface zone 20 to 40 microns thick, which was produced by controlled deformation and subsequent recrystallization. Such a zone meets the requirements of interface cohesion and is identical to the substrate in chemical composition and elastic parameters. Crystals with the surface zone exhibit a tripling of the yield stress and a Stage I work-hardening rate not much lower than that of Stage II. Relaxation data for modified crystals showed large recovered strains (about an order of magnitude larger than that for single crystals) up to prestrains of 10^{-3}. Above this prestrain the recovered strain was essentially the same as for copper single crystals in Stage I. Results of forest dislocation etch pit studies in conjunction with the findings indicate that for constrained crystals, dislocations tend to be blocked below the coating/substrate interface. These dislocations cause stress concentrations (mostly due to screw dislocations), thereby playing a major role in producing an observed forest dislocation build-up. Some comparative studies were also made on copper plated single crystals. (auth)

4742 (EFI-14(73)) THEORY OF STRONGLY COMPRESSED MATTER. Gol'dman, I. I. (Erevanskij Fizicheskij Inst. (USSR)). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Formulae for Coulomb energy of most symmetrical lattices are derived. The method proposed reduces summation over crystal lattices to some integrals over θ functions of Jacobi. There are indications about instability of simple cubic lattice as regards rhombic deformations. (auth)

4743 (EURISOTOP-54) PLASTIC CONCRETE: DEVELOPMENT AND POTENTIAL APPLICATIONS. Toyer, M. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). May 1973. 35p. (In French). Dep. NTIS (U. S. Sales Only) $3.75.

Plastic concrete is a new construction material perfected in the nuclear research laboratories of the United States. This booklet gives a brief summary that will serve as an introduction to the specialized literature and possibly will permit the resolution of some problems of construction or of industrial technology that remain unsolved. (tr-auth)

4744 (GEPP-114) AN IMPROVED METHOD FOR THE CHEMICAL ANALYSIS OF HIGH-ALUMINA CERAMICS. Walton, R. 5 Oct 1973. Contract AT(29-2)-656. 15p. Dep. NTIS $3.00.

A new method of easily and quickly determining the percent alumina in ceramic bases is presented. This new technique fuses the ceramic into a glass pellet with lithium tetraborate, then measures the impurity concentrations using x-ray-emission spectroscopy. This new method requires only eight hours to complete, as compared with 60 hours for the wet chemical technique of ASTM-C-573. (auth)

4745 (INP-831) EFFECT OF HEAT TREATMENT ON THE STRUCTURE OF THE HEUSLER ALLOY Ni_2MnIn. Soltys, J.; Tomkowicz, Z. (Institute of Nuclear Physics, Krakow (Poland)). Mar 1973. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

The effects of cooling rates on the order of atoms in the Heusler alloy Ni_2MnIn were investigated. All possible types of disordered structure were considered. It was observed that the value of the disordering parameter is larger when the cooling proceeds at a faster rate. In this alloy, Mn–In type disorder seemed to be preferred. (auth)

4746 (INP-834) DEVELOPMENT OF THE MOESSBAUER SPECTROSCOPY IN POLAND. Bara, J. J.; Hrynkiewicz, A. Z. (Institute of Nuclear Physics, Krakow (Poland)). 1973. 27p. (In Polish). Dep. NTIS (U. S. Sales Only) $3.50.

A short review of the development of Möessbauer spectroscopy in Poland and a list of publications is given. (99 references) (tr-auth)

4747 (IS-EPA-2) METALLURGICAL UPGRADING OF AUTOMOTIVE SCRAP STEEL. Final Report, June 1, 1971 – May 31, 1973. Carlson, O. N.; Schmidt, F. A. (Ames Lab., Iowa (USA)). 1973. 90p. Dep. NTIS $5.45.

Several melting and casting techniques which have been successfully used for purifying refractory metals were evaluated as methods of upgrading automotive scrap steel. These methods include (1) nonconsumable electrode arc melting, (2) electron beam melting, (3) vacuum arc melting, (4) vacuum induction melting and (5) electroslag remelting. The removal of copper, chromium, and tin from the scrap was of primary interest since these impurity elements are not removed during the steelmaking process but are known to adversely affect the mechanical properties of steel. The optimum conditions for impurity removal by melting techniques were determined using simulated auto scrap in small scale melting experiments. (JRD)

4748 (IS-M-13) CATALYSIS OF CO TO CO_2 BY RARE EARTH OXIDES; ACTIVATION OF Tb_4O_7. Gerstein, B. C.; Macaulay, D.; Chang, K. (Iowa State Univ. of Science and Technology, Ames (USA)). 1973. 4p. (CONF-730402-12). Dep. NTIS $3.00.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

Terbium Oxide, Tb_4O_7, was found to catalyze the oxidation of CO to CO_2 after activation at 350°C in the presence of CO and O_2. Conversion (92%) of CO to CO_2 was obtained at 350°C. The observed activation energy for the conversion utilizing the activated oxide was found to be 0.89 (5) Kcal/mole. Tb_4O_7, Er_2O_3, Gd_2O_3 and Lu_2O_3 were found to be ineffective as catalysts for the conversion of CO and NO to CO_2 and N_2 between 20°C and 450°C. (auth)

4749 (JINR-P4-7426) SOME PECULIARITIES OF ASYMPTOTIC RELATIONS FOR MODEL SYSTEMS. Bogolyubov, N. N.; Brankov, I. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The correlation function properties are studied for some class of model systems in the thermodynamical limit. The coincidence is proved for the averages from operators on initial and approximating Hamiltonians for the case of absence of degeneracy of the statistical equilibrium state. (auth)

4750 (K-1845) EVALUATION OF THE USE OF EDDY CURRENTS TO MEASURE THE THICKNESS OF NICKEL PLATING ON CARBON STEEL. Smith, J. H. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 17 Oct 1973. Contract W-7405-eng-26. 35p. Dep. NTIS $4.00.

The capability of using eddy current techniques to measure the thickness of nickel plating on carbon steel is investigated. Factors examined are the influence of: different plating baths (Watts and Sulfamate), different substrates (A285 and A516 carbon steels), and the effects of using different types of eddy current instrumentation (phase sensitivity versus amplitude sensitivity). The results show that the thickness of nickel plating (for the conditions described) can be measured accurately using eddy current techniques, if proper procedures are followed. These procedures are described along with many other variables that are associated with tests of this type. (auth)

4751 (KFK-1855) INFLUENCE OF GRAIN SIZE ON THE CREEP-RUPTURE AND CREEP-BEHAVIOUR OF THE AUSTENITIC CrNi-STEEL X8 CrNiMoVNb 1613. Scholz, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Aug 1973. 92p. (In German). Dep. NTIS (U. S. Sales Only) $6.75.

Thesis. Submitted to Karlsruhe Univ. (West Germany).

The average grain size of the specimens varied between 2 and 400 μm. The creep tests were performed in the temperature range of 575 to 750°C and at nominal stresses between 22 and 38 kg/mm^2. In addition, tensile tests were performed in order to study strain hardening behavior as a function of the grain size. At a stress of 28kg/mm^2 and a temperature of 650°C the initial strain ϵ_{cw} and the rate of hardening increase with the grain size. For each grain size, the creep rate shows a well-defined minimum, independent of the stress and temperature. The influence of the grain size on the minimum creep rate decreases with increasing temperature. The time to rupture (t_B) depends on the grain size and passes through a maximum. The time to rupture does not change to the same degree as the minimum creep rate. The 1%-yield time ($t_{1\%}$) is affected by the grain size to the same extent as the minimum creep rate. The ratio $t_{1\%}/t_B$ goes through a maximum as a function of the grain size. The maximum value $t_{1\%}/t_B$ increases with decreasing temperature. During the creep tests, particles of niobium carbide precipitate on the dislocation lines. (auth)

4752 (KFKI-73-42) MOESSBAUER STUDY OF THE MAGNETIC PHASE TRANSFORMATIONS IN Mn_3SnN. Nagy, D. L.; Senateur, J. P.; Zimmer, G. J.; Lohner, T.; Bibicu, I. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Aug 1973. 11p. (CONF-730946-1). Dep. NTIS(U. S. Sales Only) $3.00.

From fifth international conference on Mössbauer spectrometry; Bratislava, Romania (2 Sep 1973).

Changes of the hyperfine field observed at the nucleus of diamagnetic Sn confirm that Mn_3SnN undergoes magnetic phase transformations at 175 and 230 K and that T_N= 475 K. A magnetic phase transformation of first order was found at 350 K. A nonvanishing hyperfine field existing in the cubic antiferromagnetic phase shows that anisotropic contributions of dipole field character can not be neglected. The role of such contributions is discussed in terms of a phenomenological model. (auth)

4753 (KFKI-73-43) MAGNETIC STRUCTURE OF Mn_3SnN ABOVE 350 K. Nagy, D. L.; Zimmer, G. J.; Barberon, M.; Senateur, J. P. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1973. 7p. (CONF-730821-4). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on magnetism; Moscow, USSR (22 Aug 1973).

Tin-119 Mössbauer, x-ray, and magnetization measurements were performed on Mn_3SnN above 230°K. Weak ferromagnetism ($\leq 0.012\ \mu_B$ per Mn atom) was found in the temperature range 230 to 475°K. A first-order phase transformation exists at 350°K. The Néel transition at 475°K is shown to be of second order. The data, together with Landau's theory of phase transformations, permit the determination of the possible magnetic structures in the 350 to 475°K phase. The most probable structure is collinear, with tetragonal magnetic symmetry. (auth)

4754 (KFKI-73-52) IMPURITY EFFECTS IN ANTIFERROMAGNETS. Pal, L.; Tarnoczi, T. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Sep 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

A strong magnetic field below the Néel point, the impurities start to migrate in the lattice, resulting in a nonuniform impurity distribution and a weak spontaneous magnetization with unidirectional anisotropy. A simple theory is proposed for the impurity migration in terms of a vacancy mechanism. Kinetics of migration and the temperature dependence of the induced highly anisotropic net magnetization are studied in $Ni_{1-x}Mn_{1-x}Cu_{2x}$ ($x < 0.04$) alloys. (5 figures) (DLC)

4755 (LA-5245-MS) ELECTRONIC SYSTEM FOR DROP SMASHER. Rupert, G. N. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1973. Contract W-7405-eng-36. 2p. Dep. NTIS $4.00.

A drop smasher is used to rapidly quench a liquid metal drop from an elevated temperature. The quenching action is effected by rapidly closing two metal plates upon the falling drop. (DLC)

4756 (LA-5325) EXPERIMENTAL TECHNIQUE FOR DETERMINING FOUR ELASTIC PROPERTIES OF ANISOTROPIC, HEMISPHERICAL SHELLS. McCormick, R. N. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 7p. Dep. NTIS $4.00.

An experimental technique is described for determining four elastic properties of thin, hemispherical, axisymmetric shells, using the shells as the test specimens. The results of applying this approach to approximate the elastic properties of three nonhomogeneous shells are presented and discussed. (auth)

4757 (LA-tr-73-51) FUNDAMENTALS OF CYCLIC THERMOCHEMICAL PROCESSES. Barnert, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Jun 1973. Translation of JUL-967-RG. 75p. Dep. NTIS $5.75.

Relations between heat and work and the thermodynamic data on chemical reactions are derived on the basis of a group of homogeneous regions, using the theory of irreversible processes. The various types of entropy production and the associated reductions in efficiency are given special consideration. Statements can thereby be made concerning cyclic thermochemical processes, particularly the cyclic thermochemical process by which hydrogen and oxygen are produced from water. (auth)

4758 (LA-UR-73-1594) MULTIPARAMETER CELL SORTING AND ANALYSIS. Steinkamp, J. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 23p. (CONF-731007-1). Dep. NTIS $3.25.

From 1st symposium on mammalian cells; probes and problems; Los Alamos, New Mexico, USA (17 Oct 1973).

Improved multisensor cell sorting instrumentation for quantitative analysis and sorting of cells has been developed. Cells stained with fluorescent dyes enter a flow chamber where cell volume, fluorescence, and light scatter sensors simultaneously measure multiple cellular properties. Cells then emerge in a liquid jet that is broken into uniform liquid droplets. Sensor signals are electronically processed in one of several ways and are displayed as pulse-amplitude frequency distribution histograms using a multichannel pulse-height analyzer. Processed signals activate cell sorting according to preselected parametric criteria by electrically charging droplets containing cells and electrostatically deflecting them into collection vessels. Illustrative examples of multiparameter cell analysis and sorting experiments using cultured mammalian cells, a model mouse tumor cell system, and animal leukocytes are presented. (auth)

4759 (LBL-1493) LOW-TEMPERATURE TOUGHNESS OF BCC Fe–Ni–Ti ALLOYS. Sasaki, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1973. Contract W-7405-eng-48. 126p. Dep. NTIS $8.50.

Thesis.

The microstructural and kinetic factors controlling low-temperature toughness such as recrystallization, substructure, grain size, precipitation hardening, austenite formation, and retained austenite were systematically investigated on interstitial-free bcc Fe–Ni–Ti alloys. Among these factors, the grain size was found to be most influential. The enhancement of low-temperature toughness by controlling these microstructural factors was accomplished. As a result, a new cryogenic alloy with the extraordinary combination of strength and toughness was developed. The Fe–12Ni–0.5 Ti alloy has a yield stress of ~200 ksi and a V-notch impact energy of ~100 ft-lbs at –267°C (6°K). Up to this date, no comparable results have been reported. The effect of the grain size on the ductile–brittle transition temperature, T_c, was also investigated. There exists a shift from a low grain size dependence on T_c to a high grain size dependence at grain size ~5μ. When the grain size is reduced to less than 3μ, the ductile–brittle transition is suppressed to a lower temperature and does not appear even at temperatures very close to absolute zero. Hence, having the bcc structure in iron alloys is a necessary condition for the presence of the transition, but not a sufficient one. (auth)

4760 (LBL-1866) PHOTOCHEMICAL STUDIES OF ALKALI HALIDE VAPORS. Earl, B. L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1973. Contract W-7405-eng-48. 224p. Dep. NTIS $13.25.

Thesis.

An apparatus has been constructed for studying the photodissociation of alkali halides to produce excited alkali metal atoms. The key component is a low pressure H_2 arc continuum uv source. Radiation from this source, modulated by a chopping wheel and analyzed by a monochromator, enters a cell containing the alkali halide vapor. In the appropriate wavelength range, photodissociation occurs to produce the alkali atom in an excited ^{2}p state, the flourescence from which is detected by a photomultiplier-lock-in amplifier combination. (auth)

4761 (LBL-2135) ELECTROPHOTOLUMINESCENCE OF CHLOROPLASTS AND ITS RELATION TO PHOTOSYNTHETIC MECHANISMS. Ellenson, J. L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 111p. Dep. NTIS $7.75.

Thesis.

4762 (LBL-2205) PHASE DISTRIBUTION IN SOLID-LIQUID-VAPOR SYSTEMS. Aksay, I. A.; Hoge, C. E.; Pask, J. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1973. Contract W-7405-eng-48. 38p. (CONF-730845-1). Dep. NTIS $4.00.

From surfaces and interfaces of glass and ceramics symposium; Alfred, New York, USA (27 Aug 1973).

The thermodynamics of nonequilibrium conditions in a solid–liquid–vapor system are discussed. Spreading and subsequent pull-back phenomena in wetting studies are explained by dynamic interfacial tension. Such phenomena play a role in the initial-particle arrangement and solution–precipitation stages of liquid-phase sintering. Results of sessile-drop experiments and permeation studies are reported. (DLC)

4763 (NP-19878) DIVISION OF MECHANICAL ENGINEERING ANNUAL REPORT, 1971–1972. (Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia)). [nd]. 89p. Dep. NTIS (U. S. Sales Only) $6.50.

The nature and progress of research and information on current publications in the fields of engineering thermodynamics and fluid dynamics include data on controlled environment engineering (with particular reference to comfort cooling in tropical areas), stored products engineering (including heat and mass transfer processes), the utilization of solar energy, industrial fluid dynamics, and argricultural mechanization. The programs are closely associated with industry. (MOW)

4764 (ORNL-NSF-EP-60) LABOR COMMUTING SUBAREAS OF THE EAST TENNESSEE DEVELOPMENT DISTRICT. Kerley, C. R. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 29p. Dep. NTIS $3.50.

4765 (ORNL-TM-4340) CORROSION STUDIES. The Corrosion of Copper and Copper Alloys in High Temperature Sodium Chloride Solutions. Water Research Program Final Report, March 15, 1966–October 31, 1972. Griess, J. C. Jr.; Bacarella, A. L.; Bohlmann, E. G. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 138p. Dep. NTIS $9.00.

Results obtained during the last six years in a study aimed at evaluating the effects of selected impurities in saline waters on the corrosion of copper and copper alloys are summarized. Although funding of this program was terminated with many questions outstanding, much useful and significant information about the behavior of copper and copper alloys, and to a lesser extent nickel, in sodium chloride solutions at temperatures as high as 200°C were developed and are presented. (JRD)

4766 (ORNL-tr-2714) EMPIRICAL LAWS AND ASSOCIATED THEORY ON FATIGUE CRACK GROWTH. Kitagawa, H. (Tokyo Univ.). Translated from Zairyo; 21: 710-719(1972). 23p. Dep. NTIS $3.25.

Factors and theories associated with stable fatigue-crack growth are reviewed. Discussions are included on laws and theory of empirical, semi-empirical, and dimensional analyses. Discussions are also included on theory of work hardening and its accumulation, theory of slip in a fixed direction, models of cracking, and other theories. (JRD)

4767 (ORNL-tr-2737) FATIGUE STRENGTH AND FATIGUE DEFORMATION OF S50C STEEL UNDER RANDOM LOAD. Tanaka, T.; Yamamoto, S. Translated from Zairyo; 22: No. 237, 550-555(1973). 11p. Dep. NTIS $3.00.

A pseudo-random noise generator and a tensile-compressive type electro-compressive servo mode fatigue testing machine were used to study the behavior of smooth test pieces of annealed S50C carbon steel under sine wave load and under random load for the doubly vibrating state and for mean stress $\sigma_m = 20$ kg/mm^2. Fatigue deformation was also measured in the latter case, and the fatigue behavior under both types of loads was compared and discussed. Results show that the fatigue limits under sine wave load and under random load were nearly coincident when the fatigue strength was processed in terms of maximum stress σ_{pmax}. The increase in fatigue deformation for both load types followed the same trend as the creep curve. When the behavior was divided up into initial strain ϵ_o, strain rate A, and final strain ϵ_N and compared in terms of σ_{pmax}, both ϵ_o and ϵ_N for the random load case were smaller. In the case of strain rate A, it was found that the strain rate obtained by experiment was larger than the strain rate under random load predicted from the strain rate A under sine wave load and the frequency distribution of peak stress σ_p. This is a problem that awaits future scrutiny. (auth)

4768 (SCL-DC-720088) SOME OBSERVATIONS ON THE FORMATION OF SURFACE MARTENSITE IN 304L STAINLESS STEEL. Odegard, B. C. (Sandia Labs., Livermore, Calif. (USA)). Oct 1973. Contract AT(29-1)-789. 13p. Dep. NTIS $3.00.

A surface martensite was observed in a 304L stainless steel. The morphological details as influenced by polishing techniques and thermal quenching are discussed. The quantity of martensite was found to be greatly amplified by the strain energy produced by mechanical polishing. (auth)

4769 (SGAE-2168) ELIMINATION OF VIRUSES FROM POTATO PLANTS BY MEANS OF TISSUE CULTURE. Schmidt, J. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Landwirtschaft). Aug 1973. 24p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

4770 (SLA-73-514) EFFECTS OF ATMOSPHERIC TURBULENCE ON OPTICAL RESOLUTION AT TONOPAH TEST RANGE. Hessel, K. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1973. Contract AT(29-1)-789. 61p. Dep. NTIS $5.25.

4771 (SLA-73-620) THERMAL-SHOCK MODELING OF CARBON FIBER/CARBON MATRIX COMPOSITES. Guess, T. R.; Butler, B. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1973. Contract AT(29-1)-789. 21p. Dep. NTIS $4.00.

A three-dimensional orthogonal micromechanical model that can be used to predict the room-temperature thermal and mechanical properties of continuous filament carbon–carbon composites from the properties, volume fractions, and orientations of the constituents has been developed. The model and the properties of four carbon fibers and four pyrocarbon matrices are used in a parametric study to evaluate the potential thermal shock resistance of various fiber, matrix, volume fraction, and orientation combinations. There is reasonable agreement between limited experimental data for actual carbon–carbon composites and numerical predictions based on the model and constituent properties. Numerical results suggest that graphitized 3D composites of high fiber modulus and low fiber volume will have the greatest thermal shock resistance. (auth)

4772 (SLA-73-940) PITOT PROBE MEASUREMENTS WITHIN THE LAMINAR BOUNDARY LAYER ON A RAPIDLY SPINNING OGIVE CYLINDER IN SUPERSONIC FLOW. George, O. L. Jr; Ragsdale, W. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 50p. Dep. NTIS $4.50.

A chronology, from inception to post-mortem analysis, of a unique boundary-layer survey test is presented. Pitot pressure surveys of the laminar boundary layer on a tangent ogive cylinder spinning at rates as high as 23,000 rpm in Mach numbers 3 and 4.1 flow are described. The spin rates and Mach numbers are typical of those experienced by spin-stabilized projectiles, and the model shape is typical of these spin-stabilized projectiles. This type of data is of great utility in understanding the Magnus phenomenon, but has heretofore been available only for very slow spin rates in incompressible flow conditions. (auth)

4773 (SLA-73-5160) BONDING CHARACTERISTICS OF GOLD IN ULTRAHIGH VACUUM. Cuthrell, R. E.; Tipping, D. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1972. 9p. (CONF-731018-1). Dep. NTIS $3.00.

From 19th annual holm seminar on electric contact phenomena; Chicago, Illinois, USA (15 Oct 1973).

Results are reported of a study of the factors that affect the solid-phase bonding of gold wire electrical leads. Gold surfaces were cleaned by sputtering and joined maintaining precise control of mechanical and environmental variables. Contact resistance measurements as a function of load, coefficients of adhesion, and laser interference fringe photomicrotopographs were used as diagnostics to show the effects of cleaning, annealing, loading, and creep. Ultrahigh-vacuum techniques and vibration isolation were essential to reproducibly forming and measuring the strengths of solid-phase bonds between gold samples and between gold and tungsten. (auth)

4774 (SLA-73-5604) DESIGN AND CONSTRUCTION OF A LOW-VELOCITY BOUNDARY-LAYER TEMPERATURE PROBE. Blackwell, B. F.; Moffat, R. J. (Sandia Labs., Albuquerque, N. Mex. (USA); Stanford Univ., Calif. (USA)). 1973. 14p. (CONF-730728-1). Dep. NTIS $3.00.

From AIAA/ASME thermophysics and heat transfer meeting; Boston, Massachusetts, USA (15 Jul 1973).

A small thermocouple temperature probe was designed and fabricated for use in low-velocity turbulent boundary-layer studies. The primary probe design objective was the elimination of temperature errors due to conduction along the thermoelectric elements. It is shown that not only probe geometry but also the thermal characteristics of the two thermoelectric elements influence conduction errors. Design curves for four common thermoelectric pairs are presented. An experimental turbulent boundary-layer temperature profile is presented and compared with the theoretical laminar sublayer equation to verify that the designed probe was free of conduction errors. (auth)

4775 (SLA-73-5793) MEAN FLOW MEASUREMENTS IN HYPERSONIC TURBULENT NOZZLE WALL BOUNDARY LAYERS. Peterson, C. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 44p. (CONF-730932-2). Dep. NTIS $4.25.

From 40th semi-annual meeting of the Supersonic Tunnel Association; Bedford, UK (24 Sep 1973).

Boundary-layer pitot and total-temperature surveys were made at two stations on the wall of the Sandia Laboratories $M = 14$ Hypersonic Wind Tunnel nozzle. Static pressure and temperature data were obtained at ten stations along the nozzle. All of these measurements were made at two test section Reynolds numbers of 3.38×10^6 and 1.43×10^6 per meter. (JRD)

4776 (SLA-73-5849) SHOCK HARDENED PCM SYSTEM WITH DATA STORAGE CAPABILITY. Barnes, D. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 22p. (CONF-731016-2). Dep. NTIS $3.25.

From international telemetering conference; Washington, District of Columbia, USA (9 Oct 1973).

A miniature shock-hardened Pulse Code Modulation (PCM) system with data storage capability was developed for use in earth and water penetration tests where rf transmission is either difficult or impossible. (DLC)

4777 (SLL-73-52) CORROSION OF CF-2042 CABLE. Johnson, H. R. (Sandia Labs., Livermore, Calif. (USA)). Oct 1973. Contract AT(29-1)-789. 29p. Dep. NTIS $3.50.

Corrosion was observed between the copper-plated eyelets and aluminum conductor strip on flat flexible laminated cables of 1100 aluminum and polyimide film bonded together with a fluorcarbon adhesive. It has been determined that the corrosion is caused by, and primarily occurs during, the cyanide copper plating of the eyelets. Plating the eyelets with copper from a pyrophosphate bath eliminates this corrosion. (auth)

4778 (SLL-73-60) ELECTRON BEAM WELDABILITY OF HIGH-NITROGEN AUSTENITIC STAINLESS STEEL. Brooks, J. A. (Sandia Labs., Livermore, Calif. (USA)). Oct 1973. Contract AT(29-1)-789. 22p. Dep. NTIS $3.25.

A study of four high-nitrogen austenitic stainless steel alloys has shown those alloys to be difficult to electron beam weld. Their weldability is very sensitive to welding parameters, and is directly related to the nitrogen content. A possible mechanism to explain the observed erratic welding behavior is proposed. (auth)

4779 (SLL-73-62) ESTIMATION OF KILL PROBABILITIES FOR ARRAYS OF TARGETS. Humphrey, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1973. Contract AT(29-1)-789. 28p. Dep. NTIS $3.50.

4780 (SLL-73-5278) ELECTROMAGNETIC TRANSMISSION AND DETECTION AT DEEP DEPTHS. Starkey, D. B. (Sandia Labs., Livermore, Calif. (USA)). Sep 1973. Contract AT(29-1)-789. 17p. (CONF-730843-1). Dep. NTIS $3.00.

From through-the-earth electromagnetic workshop; Golden, Colorado, USA (15 Aug 1973).

An antenna sensitive to a vertical magnetic field was lowered into two different wells to measure attenuation versus depth and frequency of an electromagnetic wave. The tests were conducted in a 7400-foot-deep well in Nevada and an 11,000-foot-deep well in Wyoming that had conductivities ranging from 0.0025 mhos/m to 0.25 mhos/m. A surface dipole antenna with an area of $\sim 10^6$ m^2 was deployed on the surface and constant-frequency signals of 5, 10, and 20 Hz were transmitted through the Earth, utilizing less than 100 watts of power. Curves depicting the attenuation versus depth and frequency, measured $S + N/N$ ratio, and the correlation with a simple two-layer media model neglecting reflections are included. (auth)

4781 (UCID-16328) STRAIN HARDENING IN THE HEMP CODE. Bradley, W. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jul 1973. Contract W-7405-eng-48. 18p. Dep. NTIS $3.00.

The Prandtl–Reuss equations used in the HEMP elastic-plastic computer program are satisfied exactly for elastic, perfectly plastic materials, and are less exact for materials that strain harden. A new method is described for incorporating strain hardening into the flow law that is exact for linear strain hardening and very nearly exact for nonlinear strain hardening. A tensile test of a strain-hardening material is simulated using the present method and the previous method. The original approximate method has an accumulated error of less than 2% when compared with the present method. The present method agrees with exact calculations to within 0.05%. (auth)

4782 (UCRL-13582) BREM II: A CODE FOR CALCULATING THE FREE–FREE GAUNT FACTOR IN AN ARBITRARY ATOMIC POTENTIAL. Green, J. M. (R and D Associates, Santa Monica, Calif. (USA)). Jun 1973. 38p. (RDA-TR-237-AEC). Dep. NTIS $4.00.

Free–free absorption is one of the dominant mechanisms governing the absorption of laser radiation by materials heated to temperatures of 0.5 to 2.0 eV. This report describes the theory, the listing, and the running instructions for a code which computes the free–free Gaunt factor, arising from any given ionic or atomic potential. The calculation makes use of partial wave expansion. The code is capable of computing up to 95 partial waves. The code computes the necessary low energy wave functions by making use of the Green's function solution rather than by directly integrating Schroedinger's equation. In addition to the Gaunt factor, the code also provides the amplitude and the phase shift of every partial wave considered. (auth)

4783 (UCRL-13584) DEVELOPMENT OF A TUBE HEATER SYSTEM FOR LOW-MELTING-POINT METALS. Hudson, C. L.; Sever, D. L. (EG and G, Inc., Goleta, Calif. (USA)). Jul 1973. Contract AT(29-1)-565. 18p. (EGG–565-110; SANL–171-7). Dep. NTIS $3.00.

Development of a prototype system designed to facilitate the injection of low-melting-point metals through a long, restricted-diameter tube into a receiver volume is described. Investigations were also made concerning methods of distributing the injected melt in an acceptable spray pattern inside the receiver. A model was built incorporating a Lawrence Livermore Laboratory (LLL) designed and fabricated melting chamber so that the feasibility of the complete injection system could be demonstrated. (auth)

4784 (UCRL-51446) STIMULATED BRILLOUIN AND BACKWARD RAMAN LIGHT SCATTERING. Bonnett, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Oct 1973. Contract W-7405-eng-48. 56p. Dep. NTIS $5.00. Thesis.

The definition, production, and properties of brillouin and Raman scattering using lasers are discussed. (JFP)

4785 (UR-3490-308) THE MANGANOUS-ADENOSINE TRIPHOSPHATE SYSTEM: A REINVESTIGATION OF ITS PROTON MAGNETIC RESONANCE SPECTRA. Wee, V.; Feldman, I.; Rose, P.; Gross, S. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1973. 39p. (CONF-730807-6). Dep. NTIS $4.00.

From 166th American Chemical Society national meeting; Chicago, Illinois, USA (26 Aug 1973).

A reinvestigation of the Mn^{2+}-induced broadening of the H_8 and H_2 pmr signals of adenosine triphosphate was carried out. Contrary to the literature, Mn^{2+} does not cause equal broadening of the H_8 signals of ATP and AMP. Rather, for an equimolar ATP and AMP mixture, 0.25M each, containing 5.0×10^{-5}M Mn^{2+} in D_2O at pD 8 and 27°C, the ATP H_8 signal was braodened 3.90 times as much as the AMP signal. When the Mn^{2+} concentration was

1.0×10^{-4}M, as in the literature, the ratio of these broadenings was less certain, but was between 3.1 and 6.6. (MCW)

4786 (WASH-1188-73) PHYSICAL RESEARCH PROGRAM: RESEARCH CONTRACTS AND STATISTICAL SUMMARY. (USAEC Division of Physical Research, Washington, D. C.). 1 Jul 1973. 41p. GPO $0.70.

4787 (Y-DK-97) DETERMINING CHROMIUM IN INDUSTRIAL WASTE WATER BY FLAMELESS ATOMIC ABSORPTION SPECTROSCOPY. Morrow, R. W.; McElhaney, R. J. (Oak Ridge Y-12 Plant, Tenn. (USA)). 12 Sep 1973. Contract W-7405-eng-26. 25p. (CONF-731034-1). Dep. NTIS $3.50.

From 4th international conference on atomic spectroscopy; Toronto, Canada (29 Oct 1973).

Flameless atomic absorption has proven to be a rapid, accurate, and sensitive method to determine sub mg/liter quantities of chromium in effluent waste waters. The element is somewhat unique among those determinable by graphite furnace atomization because of its apparent freedom from interferences. (auth)

CORPORATE INDEX

In the Corporate Index, technical report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

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INIS: Authority List for Corporate Entries and Report Number Prefixes (IAEA-INIS-6) is used in the standardization of corporate entries. IAEA-INIS-6 is available from INIS Section, International Atomic Energy Agency, P. O. Box 590, A-1011, Vienna, Austria and from the U. S. Atomic Energy Commission, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

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Because of problems involved in the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

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SUBJECT INDEX

The subject indexing of literature announced in *Nuclear Science Abstracts* is based on the use of descriptors* selected from a controlled thesaurus of terms. Subject descriptors and qualifiers (subheadings) are selected and presented in the following format:

SUBJECT DESCRIPTOR/QUALIFIER
Title (supplementary information), volume number:abstract number

For example:

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AGE ESTIMATION/FISSION TRACKS
  Kinetics of fission track disappearance in muscovite
    mica, 28:18240 (CONF-700705--(Vol.2))
AGE ESTIMATION/RESEARCH PROGRAMS
  Report on the work of the Institute of Nuclear Sciences.
    Progress report 20, July--December 1972 (Lower Hutt,
    New Zealand), 28:19867 (INS--593)
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  Technique for preparing electron-microscopy specimens
    from reactor fuel elements, 28:18198

MILLSTONE-3 REACTOR/REACTOR SAFETY
  Preliminary safety analysis report, Amendment 7;
    responses to AEC questions, 28:20493 (DOCKET-50423--22)
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MILNE PROBLEM/NUMERICAL SOLUTION
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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

All index entries cite *NSA* volume and abstract numbers; the volume number precedes the colon and the abstract number follows it. Report numbers, where applicable, are included in parentheses after the abstract number. Published literature (journal article or book) can be identified by the absence of a report number.

The descriptors selected for use as subject terms are generally the names of specific materials, things, and processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in the original literature, rather than words that may appear in the article. Within the available thesaurus terms, indexers select what seems the most probable or logical place to look for typical information. However, users of the index should consider synonymous or closely related terms.

Information is indexed for the greatest use to the greatest number of users. This requires that a topic be indexed using subject entries that most specifically describe it and not ordinarily its ultimate use. Only the most specific subject entries are made for a given topic. For example, information on the Yankee-Rowe nuclear power plant is indexed using the subject descriptor ROWE YANKEE REACTOR but not NUCLEAR POWER PLANTS, POWER REACTORS, or PWR TYPE REACTORS. For the broader term and narrower term relationships of descriptors, refer to IAEA-INIS-13.

Specific and general examples can be given as guidance, but for complete understanding, a study should be made of subject entry patterns used to index specific information.

The standard indexing patterns used for some specific subject areas follow.

REACTOR TECHNOLOGY

Subject terms for reactors are of three types: (1) specific reactor names, e.g., BEPO REACTOR, INDIAN POINT-1 REACTOR; (2) reactors having a common physics or engineering characteristic, e.g., FBR TYPE REACTORS, SODIUM COOLED REACTORS; and (3) reactors having a common purpose, as POWER REACTORS, RESEARCH REACTORS.

Information on a specific reactor is indexed using the subject descriptor for that reactor name. Information on classes or types of reactors is indexed using subject descriptors for all applicable reactor types. For example, an article on a sodium-cooled fast breeder power reactor, without a specific name, is indexed using FBR TYPE REACTORS, SODIUM COOLED REACTORS, and POWER REACTORS. Where applicable, subject descriptors that name reactor components may be used, e.g., FUEL ELEMENTS, even though the term is also used as a qualifier of a general reactor term. Indexing is provided for materials used in reactor components when the information is peculiar to the material. For example, if the article deals with corrosion of stainless steel in a sodium cooled reactor, STAINLESS STEELS would be chosen as a pertinent subject descriptor.

In general, qualifiers of reactor subject descriptors are of two types. One type expresses reactor characteristics, e.g., REACTIVITY, and the other indicates components, e.g., CONTROL ELEMENTS.

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*The descriptors used for indexing are selected from the thesaurus of the IAEA International Nuclear Information System (INIS). TIC is a major contributor to thesaurus concepts and maintenance. The thesaurus, IAEA-INIS-13, is available from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

PARTICLE INTERACTIONS OF HIGH ENERGY PHYSICS

Information on particle-particle events is indexed using subject descriptors that name the particles involved. These subject descriptors have the form PION-NUCLEON INTERACTIONS, MESON-BARYON INTERACTIONS, etc. Such terms are constructed so that the lighter particle appears first in the combination.

A citation on cross sections of pion-neutron interactions would be found by referring to the entry PION-NEUTRON INTERACTIONS/CROSS SECTIONS. This is a dual entry of descriptors corresponding to the main heading-subheading combination of a more conventional index. Each citation under this entry will consist of the title of the article or the title with additional informative words.

Subject terms are also provided for specific models and theories. For example, OCTET MODEL, STRONG-COUPLING MODEL, SYMMETRY GROUPS, etc.

CHEMISTRY

Subject descriptors in chemistry are generally names of elements, isotopes, and compounds. Qualifiers designate properties, processes, and reactions as specifically as possible.

Compounds on which there are significant quantities of information in the literature of nuclear science and technology are indexed by using specific descriptors following the nomenclature of the literature, e.g., METHYL IODIDE, TBP, 2-METHYLPROPANE, URANIUM DIOXIDE, etc.

Compounds occurring less frequently are indexed using more general terms or combinations of terms. In such cases all of the descriptors used to describe the compounds may be selected as subject terms or only the ones of main importance. In these cases the complete compound is indicated in either the title or title augmentation. For example, ethyl bromide is indexed using the subject descriptor BROMINATED ALIPHATIC HYDROCARBONS, uranyl acetates is included as URANYL COMPOUNDS, and lithium fluoroberyllates appears as LITHIUM FLUORIDES and BERYLLIUM FLUORIDES.

Terms for chemical reactions, processes, and properties are not used as subject descriptors in indexing information on specific materials. Such terms are included for publications such as books, reviews, or general treatment of the subject.

LIFE SCIENCES

Information in this area is indexed using subject descriptors for specific animals, plants, microorganisms, biochemicals, biological systems and processes, cells, organs, radiation effects, and substances modifying radiation effects. DNA, BARLEY, HELA CELLS, BEAGLES, PATIENTS, BACILLUS SUBTILIS, LACTATE DEHYDROGENASE, and CHROMOSOMAL ABERRATIONS are examples of specific subject descriptors. While most descriptors are common names, genus and species names are sometimes used, e.g., DROSOPHILA. If the specific name of an organism or biochemical is not used, the name of a higher category is used instead. For example, clams are indexed using the subject descriptor MOLLUSCS, Anopheles pharoensis using MOSQUITOS, and glutamine oxalacetic acid transaminase using TRANSFERASES. Title augmentation is used to more completely identify the organisms or substances.

Subject descriptors naming incident radiation are used only if dose, RBE, or other radiation quality studies are made.

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18283	29-3465	Dep. NTIS, $3.00
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73-P-538	29-4398	Dep. NTIS (US Sales Only), $3.00
CONF-691008-	(Symposium on radiation safety problems in the design and operation of 'hot' facilities, Saclay, France, 13-17 Oct 1969)	
19	29-3148	See RFP-Trans-139
CONF-691075-	(20. international astronautical congress, Mar del Plata, Argentina, 5-10 Oct 1969)	
	29-3191	Elmsford, NY; Pergamon Press, Inc. (1972). $52.50
CONF-700680-	(Symposium on thermal considerations in the production of electric power, Washington, District of Columbia, USA, 28-30 Jun 1970)	
	29-2653	New York; Gordon and Breach, Science Publishers, Inc. (1969).
CONF-710209-	(International conference on heavy ion physics, Dubna, USSR, 11-17 Feb 1971)	
5	29-3991	See ORNL-tr-2711
CONF-710565-	(All-Union conference on neutron physics, Kiev, USSR, 24-28 May 1971)	
P1	29-3681	Kiev; Izdatel'stvo Naukova Dumka (1972).
P2	29-3682	Kiev; Izdatel'stvo Naukova Dumka (1972).
CONF-710668-	(International symposium on identification and measurement of environmental pollutants, Ottawa, Canada, 14-17 Jun 1971)	
	29-2630	Ottawa; National Research Council of Canada (1971).
CONF-710807-	(12. international conference on cosmic rays, Hobart, Australia, 16-25 Aug 1971)	
(Vol.7)	29-3192	Hobart, Australia; International Union of Pure and Applied Physics (1971).
CONF-711155-	(6. international conference on science of ceramics, Baden-Baden, F.R. Germany, 14-18 Nov 1971)	
	29-3026	DM 50.-
CONF-720420-	(Conference on reactor materials performance, Richland, Washington, USA, 24-26 Apr 1972)	
11	29-2993	See GULF-GA-A-12051
CONF-720524-	(Meeting of the resonance region subcommittee of CSEWG, Upton, New York, USA, 8 May 1972)	
	29-4531	See BNL-50387
CONF-7205100-	(3. seminar on activation analysis, Karlruhe, F.R. Germany, 30-31 May 1972)	
(Absts.)	29-2416	See BMFT-FBK-73-23
CONF-720691-	(7. international conference on mammary tumors, Saint-Pierre-de-Chartreuse, France, 12 Jun 1972, 12 Jun 1972)	
1	29-2843	See CEA-CONF-2286
2	29-4717	See CEA-CONF-2288
3	29-4716	See CEA-CONF-2287
CONF-720694-	(Research coordination meeting on nuclear techniques for seed protein improvement, Neuherberg, F.R. Germany, 26-30 Jun 1972)	
	29-2862	See STI/PUB-320
CONF-720858-	(8. world buiatrics congress conference, London, England, UK, Aug 1972)	
1	29-4740	See COO-3400-12
CONF-720923-	(16. international conference on high energy physics, Chicago, Illinois, USA, 6-13 Sep 1972)	
16	29-3424	See JINR-P1-7027
CONF-721010-	(International conference on modern trends in activation analysis, Saclay, France, 2-6 Oct 1972)	
90	29-2465	Dep. NTIS (US Sales Only), $3.00
CONF-721066-	(5. symposium on the structure of low medium mass nuclei, Lexington, Kentucky, USA, 27 Oct 1972)	
	29-4099	Lexington, KY; University Press of Kentucky (1973). $12.50
CONF-721069-	(International colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media, Saclay, France, 2 Oct 1972)	
30	29-2417	Dep. NTIS (US Sales Only), $3.00
CONF-7210109-	(Meeting on reference methods for marine radioactivity studies - determination of transuranic elements, radioruthenium and other radionuclides in marine environmental samples, Vienna, Austria, 30 Oct-3 Nov 1972)	
1	29-2450	See COO-3563-12
CONF-721147-	(Seminar of the group of users of signal treatment, Grenoble, France, 20-21 Nov 1972)	
1	29-4695	See CEA-CONF-2298
CONF-730123-	(23. national conference on nuclear structure and atomic nuclei, Tbilisi, USSR, 28 Jan-2 Feb 1973)	
2	29-3919	See JINR-P4-6990
CONF-730131-	(Colloque Franco-Anglais Sur Les Dermatoses Professionnelles, Paris, France, 8 Jan 1973, 8 Jan 1973)	
1	29-2879	See CEA-CONF-2265
CONF-730321-	(Semiconductor detectors in medicine meeting, San Francisco, California, USA, 8-9 Mar 1973)	
3	29-4355	See FMI-1000-422
CONF-730324-	(ANS Niagara-Finger Lakes Section Student conference, Hamilton, Ontario, Canada, 9-10 Mar 1973)	
	29-2413	
CONF-730334-	(8. Recontre de Moriond conference, Meribel-les-Allues, France, 4-16 Mar 1973)	
9	29-3466	See DESY-73-21
CONF-730341-	(International cooperation in reactor material and nuclear fuels conference, Paris, France, 2 Mar 1973)	
3	29-2810	See CEA-CONF-2293
7	29-4691	See FRNC-CONF-85
CONF-730343-	(Meeting on the development of industrial applications of radiation chemistry, Paris, France, 13-14 Mar 1973)	
2	29-2817	See CEA-CONF-2324
CONF-730402-	(10. rare earth research conference, Carefree, Arizona, USA, 30 Apr-3 May 1973)	
12	29-4748	See IS-M-13
CONF-730423-	(Southern Regional Science Association meetings, New Orleans, Louisiana, USA, 26-27 Apr 1973)	
2	29-4722	Dep. NTIS, $3.00
CONF-730435-	(International seminar on nonlocal quantum field theory, Alushta, USSR, Apr 1973)	
	29-4399	See JINR-D2-7161
CONF-730450-	(Minerva symposium on physics, Rehovoth, Israel, 2-4 Apr 1973)	

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2	29-3466	See DESY-73-21
CONF-730459-	(International exhibition and congress mesucora 73 and 64 physics exhibition meeting, Paris, France, 11-18 Apr 1973)	
3	29-2797	See CEA-CONF-2348
CONF-730465-	(International symposium on vibration problems in industry, Keswick, UK, 10-12 Apr 1973)	
1	29-2591	See AECL-4514
2	29-2592	See AECL-4515
CONF-730467-	(Meeting on the applications of ion exchange chromatography and gel and thin film chromatography in chemical analysis, Paris, France, 23 Apr 1973, 23 Apr 1973)	
1	29-2464	See CEA-CONF-2338
CONF-730531-	(International conference on instrumentation for high energy physics, Frascati, Italy, 8-12 May 1973)	
9	29-2775	Dep. NTIS (US Sales Only), $4.50
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CONF-730606-	(7. International conference and exhibition on nondestructive testing, Warsaw, Poland, 4-8 Jun 1973)	
6	29-2603	See CEA-CONF-2427
CONF-730642-	(5. international conference on high-energy physics and nuclear structure, Uppsala, Sweden, 18-22 Jun 1973)	
11	29-3403	See COO-1112-185
12	29-3394	See JINR-P15-7202
CONF-730645-	(13. symposium on nuclear spectroscopy and nuclear theory, Dubna, USSR, 19-23 Jun 1973)	
	29-4045	See JINR-D6-7094
CONF-730653-	(Conference on biochemical trends in human leukemia, Hamburg, F.R. Germany, 20-22 Jun 1973)	
1	29-4723	Dep. NTIS, $3.25
CONF-730661-	(56. annual CIC meeting on the effects of surface films on the initiation of stress corrosion cracking of zircaloy-2, Montreal, Canada, 4-6 Jun 1973)	
1	29-3029	See AECL-4589
CONF-730705-	(6. European conference on controlled fusion and plasma physics, Moscow, USSR, 30 Jul-4 Aug 1973)	
23	29-4298	See CEA-CONF-2397
P1	29-4124	Dubna, USSR; Joint Institute for Nuclear Research (1973).
CONF-730709-	(8. international conference on the physics of electronic and atomic collisions, Belgrade, Yugoslavia, 16-20 Jul 1973)	
5	29-3352	See RLO-1388-224
CONF-730726-	(Symposium on fuel and elements for fast reactors, Brussels, Belgium, 2-6 Jul 1973)	
4	29-2994	See GULF-GA-A-12596
CONF-730728-	(AIAA/ASME thermophysics and heat transfer meeting, Boston, Massachusetts, USA, 15-17 Jul 1973)	
1	29-4774	See SLA-73-5604
CONF-730804-	(13. international cosmic ray conference, Denver, Colorado, USA, 17-30 Aug 1973)	
2	29-2681	See COO-1671-49
CONF-730807-	(166. American Chemical Society national meeting, Chicago, Illinois, USA, 26-31 Aug 1973)	
6	29-4785	See UR-3490-308
CONF-730813-	(Conference on defects and defect clusters in bcc metals and their alloys, Gaithersburg, Maryland, USA, 14-16 Aug 1973)	
10	29-3098	See IS-3182
CONF-730821-	(International conference on magnetism, Moscow, USSR, 22-28 Aug 1973)	
4	29-4753	See KFKI-73-43
CONF-730833-	(Chemical spectroscopy and photochemistry in the vacuum ultraviolet conference, Valmorin, Quebeck, Canada, 5-17 Aug 1973)	
3	29-4724	Dep. NTIS, $3.75
CONF-730837-	(Meeting of the division of particles and fields, Berkeley, California, USA, 13-17 Aug 1973)	
2	29-3406	See RLO-2225-T-27-3
3	29-3404	See COO-2009-58
4	29-3422	See COO-2009-59
5	29-3547	See BNL-18271
CONF-730843-	(Through-the-earth electromagnetic workshop, Golden, Colorado, USA, 15-17 Aug 1973)	
1	29-4780	See SLL-73-5278
CONF-730844-	(Conference on internal friction and ultrasonic attenuation in crystalline solids, Aachen, F.R. Germany, 27-30 Aug 1973)	
1	29-3046	See COO-1198-1014
CONF-730845-	(Surfaces and interfaces of glass and ceramics symposium, Alfred, New York, USA, 27-29 Aug 1973)	
1	29-4762	See LBL-2205
CONF-730847-	(Proceedings of the International Summer Institute in surface science, Milwaukee, Wisconsin, USA, 28-30 Aug 1973)	
1	29-3351	See LBL-2212
CONF-730906-	(11. international conference on phenomena in ionized gases, Prague, Czechoslovakia, 10-14 Sep 1973)	
10	29-4325	See CEA-CONF-2384
11	29-4260	See CEA-CONF-2385
12	29-4210	See CEA-CONF-2386
CONF-730907-	(3. international congress of the International Radiation Protection Association meeting, Washington, District of Columbia, USA, 9-14 Sep 1973)	
13	29-2629	See LA-UR-73-1309
CONF-730915-	(Symposium on noble gases, Las Vegas, Nevada, USA, 24-28 Sep 1973)	
6	29-2617	See UCRL-74710
7	29-2680	Dep. NTIS, $3.00
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CONF-730918-	(Joint power generation conference, New Orleans, Louisiana, USA, 16-19 Sep 1973)	
2	29-3147	See GULF-GA-A-12272
CONF-730932-	(40. semi-annual meeting of the Supersonic Tunnel Association, Bedford, UK, 24-26 Sep 1973)	
2	29-4775	See SLA-73-5793
CONF-730938-	(Symposium on pore structures and properties of materials, Prague, Czechoslovakia, 18-21 Sep 1973)	
1	29-2989	Dep. NTIS, $3.00
CONF-730942-	(2. international conference on structural mechanics in reactor technology, Berlin, F.R. Germany, 10-14 Sep 1973)	
	29-4545	
CONF-730944-	(11. international annual meeting of the German Society of Nuclear Medicine, Athens, Greece, 24-29 Sep 1973)	
1	29-2961	See BNL-18258
4	29-2571	See BNL-18214
CONF-730946-	(5. international conference on mossbauer spectrometry, Bratislava, Romania, 2-7 Sep 1973)	
1	29-4752	See KFKI-73-42
CONF-730947-	(Conference on the structure of the ribosome, Cold Spring Harbor, New York, USA, 4-9 Sep 1973)	
1	29-4709	See BNL-18274
CONF-730949-	(International metallography society symposium on specimen preparation for metallography, Los Angeles, California, USA, 23-24 Sep 1973)	
1	29-3049	See LA-UR-73-1398
CONF-730951-	(11. modulator symposium, New York, New York, USA, 18-19 Sep 1973)	
1	29-3163	See LA-UR-73-1320
CONF-730952-	(4. symposium on microdosimetry, Pallanza, Italy, 24-28 Sep 1973)	
1	29-2737	See BNL-18219
3	29-2834	See COO-1671-51
CONF-731005-	(13. Hanford biology symposium on the cell cycle in malignancy and immunity, Richland, Washington, USA, 1-3 Oct 1973)	
2	29-4728	See COO-2269-3
CONF-731007-	(1. symposium on mammalian cells: probes and problems, Los Alamos, New Mexico, USA,	

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	17-19 Oct 1973)	
1	29-4758	See LA-UR-73-1594
CONF-731012-	(13. international congress of radiology, Madrid, Spain, 15-20 Oct 1973)	
3	29-2880	See UCSF-10-P-2-211
CONF-731015-	(IAEA conference on physics of fast reactors, Tokyo, Japan, 16-23 Oct 1973)	
3	29-3672	See BNL-18252
CONF-731016-	(International telemetering conference, Washington, District of Columbia, USA, 9-11 Oct 1973)	
2	29-4776	See SLA-73-5849
CONF-731018-	(19. annual holm seminar on electric contact phenomena, Chicago, Illinois, USA, 15-18 Oct 1973)	
1	29-4773	See SLA-73-5160
CONF-731020-	(International heat transfer meeting, Karlsruhe, F.R. Germany, 9-11 Oct 1973)	
1	29-4457	See WCAP-8727
CONF-731022-	(Invited lecture given at Bell Telephone Laboratories, Murry Hill, New Jersey, USA, 16 Oct 1973, 16 Oct 1973)	
1	29-2452	See SLA-73-5531
CONF-731023-	(9. AESOP meeting, San Francisco, California, USA, 1-4 Oct 1973)	
2	29-4694	See Y-DE-50
CONF-731026-	(Conference on electrical insulation and dielectric phenomena, Quebec, Canada, 29-31 Oct 1973)	
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3	29-4675	
4	29-4676	
CONF-731028-	(International conference on applications of ion beams to metals, Albuquerque, New Mexico, USA, 2-4 Oct 1973)	
1	29-3096	Dep. NTIS, $3.00
CONF-731030-	(2. meeting on fundamental and practical aspects of the application of fast neutrons in clinical radiotherapy, The Hague, Netherlands, 3-5 Oct 1973)	
1	29-2833	See BNL-18234
2	29-2913	See UCSF-10-P-2-210
CONF-731034-	(4. international conference on atomic spectroscopy, Toronto, Canada, 29 Oct-2 Nov 1973)	
1	29-4787	See Y-DK-97
CONF-731101-	(Joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition, San Francisco, California, USA, 11-16 Nov 1973)	
5	29-3901	Dep. NTIS, $3.00
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18	29-2868	See RFP-2016
23	29-3139	See RFP-2105
CONF-731102-	(Symposium on technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors, Austin, Texas, USA, 20-22 Nov 1973)	
1	29-4300	See LA-UR-73-910
CONF-731103-	(IEEE northeast electronics research and engineering meeting, Boston, Massachusetts, USA, 6-8 Nov 1973)	
1	29-4706	See SLA-73-5516
CONF-731104-	(19. conference on magnetism and magnetic materials, Boston, Massachusetts, USA, 13-16 Nov 1973)	
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CONF-731109-	(66. annual meeting of the American Institute of Chemical Engineers, Philadelphia, Pennsylvania, USA, 11-15 Nov 1973)	
1	29-3628	See DPSPU-72-30-10
CONF-731110-	(Symposium on the physical behavior of radioactive containment in the atmosphere, Vienna, Austria, 12-16 Nov 1973)	
4	29-2645	See MLM-2094(OP)
5	29-2634	See BNL-18301
CONF-731113-	(American Chemical Society 25th annual southeastern regional meeting, Charleston, South Carolina, USA, 7-9 Nov 1973)	
1	29-2451	See DP-MS-73-35
CONF-731115-	(Seminar on high-energy accelerator science, Tokyo and Tsukuba, Japan, 5-9 Nov 1973)	
1	29-3164	See LA-UR-73-1568
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34	29-3575	See ORO-3992-141
53	29-3600	See ORO-3992-143
93	29-3468	See ORO-3992-43
187	29-3504	See ORO-3992-138
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DOCKET-50237-	(Dresden Nuclear Power Station, Unit 2, See also DOCKET-50010 and DOCKET-50249, Non-AEC)	
409	29-4571	Dep. NTIS, $3.00

Report No.	Abstract No.	Availability
412	29-4572	Dep. NTIS, $3.00
DOCKET-50244-	(Robert Emmett Ginna Nuclear Power Plant, Unit 1, Formerly Brookwood Nuclear Station, Non-AEC)	
212	29-4573	Dep. NTIS, $3.00
DOCKET-50245-	(Millstone Nuclear Power Station, Unit 1, Non-AEC)	
302	29-4574	Dep. NTIS, $3.00
304	29-4575	Dep. NTIS, $3.00
305	29-4576	Dep. NTIS, $3.00
DOCKET-50247-	(Indian Point Station, Unit 2, See also DOCKET-50286 and DOCKET-50003, Non-AEC)	
143	29-4577	Dep. NTIS, $3.00
145	29-4578	Dep. NTIS, $3.00
147	29-4579	Dep. NTIS, $3.00
148	29-4580	Dep. NTIS, $3.00
DOCKET-50249-	(Dresden Nuclear Power Station, Unit 3, See also DOCKET-50010 and DOCKET-50237, Non-AEC)	
308	29-4581	Dep. NTIS, $3.00
DOCKET-50250-	(Turkey Point Plant, Unit 3, See also DOCKET-50251, Non-AEC)	
168	29-4582	Dep. NTIS, $3.00
176	29-4583	Dep. NTIS, $3.00
DOCKET-50251-	(Turkey Point Plant, Unit 4, See also DOCKET-50250, Non-AEC)	
156	29-4582	See DOCKET-50250-168
DOCKET-50254-	(Quad-Cities Station, Unit 1, See also DOCKET-50265, Non-AEC)	
275	29-4584	Dep. NTIS, $3.00
281	29-4585	Dep. NTIS, $3.00
DOCKET-50255-	(Palisades Nuclear Plant, Non-AEC)	
205	29-4586	Dep. NTIS, $3.00
DOCKET-50259-	(Browns Ferry Nuclear Power Station, Unit 1, See also DOCKET-50260 and DOCKET-50296, Non-AEC)	
184	29-4587	Dep. NTIS, $3.00
185	29-4588	Dep. NTIS, $3.00
192	29-4589	Dep. NTIS, $3.00
195	29-4590	Dep. NTIS, $3.00
196	29-4591	Dep. NTIS, $3.00
200	29-4592	Dep. NTIS, $3.00
204	29-4593	Dep. NTIS, $3.00
205	29-4594	Dep. NTIS, $3.00
206	29-4595	Dep. NTIS, $3.00
212	29-4596	Dep. NTIS, $3.00
213	29-4597	Dep. NTIS, $3.00
217	29-4598	Dep. NTIS, $3.00
DOCKET-50261-	(H. B. Robinson Plant, Unit 2, Non-AEC)	
264	29-4599	Dep. NTIS, $3.00
266	29-4600	Dep. NTIS, $3.00
277	29-4601	Dep. NTIS, $3.00
DOCKET-50263-	(Monticello Nuclear Generating Plant, Unit 1, Non-AEC)	
253	29-4602	Dep. NTIS, $3.00
254	29-4603	Dep. NTIS, $3.00
257	29-4604	Dep. NTIS, $3.00
258	29-4605	Dep. NTIS, $31.00
DOCKET-50265-	(Quad-Cities Station, Unit 2, See also DOCKET-50254, Non-AEC)	
263	29-4584	See DOCKET-50254-275
268	29-4585	See DOCKET-50254-281
272	29-4606	Dep. NTIS, $3.00
273	29-4607	Dep. NTIS, $3.00
DOCKET-50266-	(Point Beach Nuclear Plant, Unit 1, Non-AEC)	
130	29-4608	Dep. NTIS, $3.00
DOCKET-50267-	(Fort St. Vrain Nuclear Generating Station, Non-AEC)	
83	29-4609	Dep. NTIS, $4.00
DOCKET-50269-	(Oconee Nuclear Station, Unit 1, See also DOCKET-50270 and DOCKET-50287, Non-AEC)	
155	29-4610	Dep. NTIS, $3.00
156	29-4611	Dep. NTIS, $3.00
160	29-4612	Dep. NTIS, $3.00
161	29-4613	Dep. NTIS, $3.00
DOCKET-50270-	(Oconee Nuclear Station, Unit 2, See also DOCKET-269 and DOCKET-50287, Non-AEC)	
127	29-4612	See DOCKET-50269-160
DOCKET-50271-	(Vermont Yankee Nuclear Power Station, Non-AEC)	
231	29-4614	Dep. NTIS, $3.00
240	29-4615	Dep. NTIS, $3.00
242	29-4616	Dep. NTIS, $3.00
244	29-4617	Dep. NTIS, $3.00
248	29-4618	Dep. NTIS, $3.00
250	29-4619	Dep. NTIS, $3.00
DOCKET-50277-	(Peach Bottom Atomic Power Station, Unit 2, See also DOCKET-50171 and DOCKET-50278, Non-AEC)	
132	29-4620	Dep. NTIS, $3.00
136	29-4621	Dep. NTIS, $3.00
141	29-4622	Dep. NTIS, $3.00
151	29-4623	Dep. NTIS, $3.00
152	29-4624	Dep. NTIS, $3.00
DOCKET-50278-	(Peach Bottom Atomic Power Station, Unit 3, See also DOCKET-50171 and DOCKET-50277, Non-AEC)	
105	29-4621	See DOCKET-50277-136
111	29-4623	See DOCKET-50277-151
DOCKET-50280-	(Surry Power Station, Unit 1, See also DOCKET-50281, Non-AEC)	
186	29-4625	Dep. NTIS, $3.00
189	29-4626	Dep. NTIS, $3.00
DOCKET-50281-	(Surry Power Station, Unit 2, See also DOCKET-50280, Non-AEC)	
156	29-4627	Dep. NTIS, $3.00
157	29-4628	Dep. NTIS, $3.00
DOCKET-50285-	(Fort Calhoun Station, Unit 1, Non-AEC)	
136	29-4629	Dep. NTIS, $3.00
137	29-4630	Dep. NTIS, $3.00
DOCKET-50286-	(Indian Point Station, Unit 3, See also DOCKET-50003 and DOCKET-50247, Non-AEC)	
99	29-4631	Dep. NTIS, $24.75
DOCKET-50287-	(Oconee Nuclear Station, Unit 3, See also DOCKET-50269 and DOCKET-50270, Non-AEC)	
104	29-4612	See DOCKET-50269-160
DOCKET-50289-	(Three Mile Island Nuclear Station, Unit 1, Non-AEC)	
130	29-4632	Dep. NTIS, $3.00
135	29-4633	Dep. NTIS, $3.00
137	29-4634	Dep. NTIS, $3.00
DOCKET-50293-	(Pilgrim Nuclear Power Station, Unit 1, Non-AEC)	
198	29-4635	Dep. NTIS, $3.00
199	29-4636	Dep. NTIS, $3.00
DOCKET-50295-	(Zion Nuclear Plant, Unit 1, See also DOCKET-50304, Non-AEC)	
192	29-4637	Dep. NTIS, $3.00
DOCKET-50298-	(Cooper Nuclear Station, Non-AEC)	
97	29-4638	Dep. NTIS, $3.00
DOCKET-50301-	(Point Beach Nuclear Plant, Unit 2, Non-AEC)	
114	29-4608	See DOCKET-50266-130
DOCKET-50305-	(Kewaunee Nuclear Power Plant, Non-AEC)	
119	29-4522	Dep. NTIS, $30.75
120	29-4639	Dep. NTIS, $3.00
121	29-4640	Dep. NTIS, $3.00
122	29-4641	Dep. NTIS, $3.00
DOCKET-50309-	(Maine Yankee Atomic Power Plant, Non-AEC)	
142	29-4642	Dep. NTIS, $3.00
146	29-4643	Dep. NTIS, $3.00
DOCKET-50313-	(Arkansas Nuclear One, Unit 1, Non-AEC)	
113	29-4644	Dep. NTIS, $3.00
DOCKET-50315-	(Donald C. Cook Nuclear Power Plant, Unit 1, See also DOCKET-50316, Non-AEC)	
148	29-4645	Dep. NTIS, $3.50
DOCKET-50317-	(Calvert Cliffs Nuclear Power Plant, Unit 1, See also DOCKET-50318, Non-AEC)	
131	29-4646	Dep. NTIS, $3.00
DOCKET-50318-	(Calvert Cliffs Nuclear Power Plant, Unit 2, See also DOCKET-50317, Non-AEC)	
115	29-4646	See DOCKET-50317-131
DOCKET-50320-	(Three Mile Island Nuclear Station, Unit 2, Non-AEC)	
57	29-4634	See DOCKET-50289-137
DOCKET-50321-	(Edwin I. Hatch Nuclear Plant, Unit 1, Non-AEC)	
101	29-4647	Dep. NTIS, $3.00
DOCKET-50327-	(Sequoyah Nuclear Plant, Unit 1, See also DOCKET-50328, Non-AEC)	
60	29-4648	Dep. NTIS, $3.00
DOCKET-50328-	(Sequoyah Nuclear Plant, Unit 2, See also DOCKET-50327, Non-AEC)	
53	29-4648	See DOCKET-50327-60

Report No.	Abstract No.	Availability
DOCKET-50331-	(Duane Arnold Energy Center, Non-AEC)	
123	29-4649	Dep. NTIS, $4.25
DOCKET-50332-	(Barnwell Nuclear Fuel Plant, Non-AEC)	
36	29-2581	Dep. NTIS, $3.00
DOCKET-50334-	(Beaver Valley Power Station, Unit 1, Non-AEC)	
89	29-4650	Dep. NTIS, $3.00
DOCKET-50336-	(Millstone Nuclear Power Station, Unit 2, Non-AEC)	
83	29-4651	Dep. NTIS, $3.00
DOCKET-50409-	(LaCrosse Boiling Water Reactor, AEC)	
74	29-4652	Dep. NTIS, $3.00
75	29-4653	Dep. NTIS, $3.75
DOCKET-50443-	(Seabrook Nuclear Station, Unit 1, See also DOCKET-50444, Non-AEC)	
19	29-4654	Dep. NTIS, $3.75
DOCKET-50444-	(Seabrook Nuclear Station, Unit 2, See also DOCKET-50443, Non-AEC)	
19	29-4654	See DOCKET-50443-19
DOCKET-50458-	(River Bend Station, Unit 1, See also DOCKET-50459, Non-AEC)	
2	29-4655	Dep. NTIS, $32.50
3	29-4656	Dep. NTIS, $25.50
4	29-4657	Dep. NTIS, $29.50
5	29-4658	Dep. NTIS, $32.25
6	29-4659	Dep. NTIS, $30.25
7	29-4660	Dep. NTIS, $32.50
8	29-4661	Dep. NTIS, $34.25
9	29-4662	Dep. NTIS, $29.00
10	29-4663	Dep. NTIS, $30.25
11	29-4664	Dep. NTIS, $29.75
12	29-4665	Dep. NTIS, $4.50
DOCKET-50459-	(River Bend Station, Unit 2, See also DOCKET-50458, Non-AEC)	
2	29-4655	See DOCKET-50458-2
3	29-4656	See DOCKET-50458-3
4	29-4657	See DOCKET-50458-4
5	29-4658	See DOCKET-50458-5
6	29-4659	See DOCKET-50458-6
7	29-4660	See DOCKET-50458-7
8	29-4661	See DOCKET-50458-8
9	29-4662	See DOCKET-50458-9
10	29-4663	See DOCKET-50458-10
11	29-4664	See DOCKET-50458-11
12	29-4665	See DOCKET-50458-12
DOCKET-STN-50437-	(Offshore Power Systems, Non-AEC)	
14	29-4666	Dep. NTIS, $33.75
DP-		
1319	29-2599	Dep. NTIS, $4.00
DP-MS-		
73-35	29-2451	Dep. NTIS, $3.25
DPC-		
851-63	29-4653	See DOCKET-50409-75
DPSPU-		
72-30-10	29-2628	Dep. NTIS, $3.00
EANDC(US)-	(Italy)	
181(U)	29-3921	See USNDC-7
EERL-TR-E-		
73-4	29-2612	Dep. NTIS, $5.45
EFI-	(Misc.)	
14(73)	29-4742	Dep. NTIS (US Sales Only), $3.00
EFI-ME-	(UK)	
2(71)	29-2777	INIS
EGG-		
565-110	29-4783	See UCRL-13584
1183-1582	29-2644	See ARMS-70.6.10
ENDF-		
134-R	29-3677	See ORNL-TM-2880(Rev.)
187	29-4531	See BNL-50387
EPA-R-		
2-73-253	29-2672	See ANL/ES-CEN-1005
EUR-	(European Atomic Energy Community)	
4874	29-2798	Dep. NTIS (US Sales Only), $8.75. EUR FB 165,-
4966	29-2642	Dep. NTIS (US Sales Only), $4.25. EUR B.Fr. 60.-
5010	29-2582	Dep. NTIS (US Sales Only), $4.75. EUR B.Fr. 60.-
5026	29-2799	Dep. NTIS (US Sales Only), $3.00. EUR BF 40,-
5037	29-4456	Dep. NTIS (US Sales Only), $4.50. EUR FB 60,-
5040	29-2573	Dep. NTIS (US Sales Only), $4.00. EUR B.Fr.50.-
5041	29-2738	Dep. NTIS (US Sales Only), $4.50. EUR B.Fr.60.-
5045	29-2421	Dep. NTIS (US Sales Only), $3.25. EUR FB 40,-
EURFNR-	(European Atomic Energy Community)	
1100	29-3982	Dep. NTIS, $7.00
EURISOTOP-	(Belgium)	
54	29-4743	Dep. NTIS (US Sales Only), $3.75
73	29-2823	Dep. NTIS (US Sales Only), $6.75
FMI-		
1000-422	29-4355	Dep. NTIS, $3.00
FRNC-CONF-	(France)	
85	29-4691	Dep. NTIS (US Sales Only), $3.75
FRNC-R-	(France)	
26	29-2778	Dep. NTIS (US Sales Only), $3.00
27	29-2779	Dep. NTIS (US Sales Only), $3.50
FRNC-TH-	(France)	
402	29-2550	Dep. NTIS (US Sales Only), $18.25
FUPH-G-	(Australia)	
4	29-4200	Dep. NTIS (US Sales Only), $3.25
FZK-	(Non-AEC)	
382	29-2684	See N-71-36493
394-1	29-3097	Dep. NTIS, $10.25
GEPP-		
111	29-3117	Dep. NTIS, $4.25
114	29-4744	Dep. NTIS, $3.00
GULF-GA-A-		
12051	29-2993	Dep. NTIS, $3.25
12052	29-3676	Dep. NTIS, $7.00
12272	29-3147	Dep. NTIS, $3.00
12596	29-2994	Dep. NTIS, $3.00
HEDL-SA-		
590	29-2682	Dep. NTIS, $3.25
HEDL-TME-		
73-38	29-2995	AT
73-51	29-2583	Dep. NTIS, $5.45
73-70	29-4503	Dep. NTIS, $5.45
73-71	29-2605	Dep. NTIS, $4.00
HIT-		
498	29-4677	
499	29-4678	
IC-	(Italy)	
73-120	29-4428	Dep. NTIS (US Sales Only), $3.00
ICP-		
1033	29-2414	Dep. NTIS, $5.45
ICRP-	(Non-AEC)	
22	29-2881	Oxford; Pergamon Press (1973).
IEA-	(Brazil)	
260	29-4356	Dep. NTIS (US Sales Only), $3.50
277	29-2494	Dep. NTIS (US Sales Only), $9.00
285	29-2432	Dep. NTIS (US Sales Only), $3.00
INDC(USA)-	(AEC Nuclear Cross Sections Advisory Committee)	
56(U)	29-3921	See USNDC-7
INIS-mf-	(International Atomic Energy Agency)	
46	29-3047	INIS
165-1	29-2639	INIS
165-2	29-2640	INIS
165-3	29-2787	INIS
165-4	29-2788	INIS
165-8	29-2623	INIS
330	29-2753	INIS
339	29-3777	INIS
360	29-2466	INIS
509	29-2754	INIS
704	29-2551	INIS
706	29-2497	INIS
768	29-3453	INIS

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777	29-3983	INIS
795	29-4429	INIS
INP-	(Poland)	
822	29-3641	Dep. NTIS (US Sales Only), $4.00
823	29-3778	Dep. NTIS (US Sales Only), $3.75
831	29-4745	Dep. NTIS (US Sales Only), $3.75
834	29-4746	Dep. NTIS (US Sales Only), $3.50
835	29-3048	Dep. NTIS (US Sales Only), $3.00
837	29-3752	Dep. NTIS (US Sales Only), $8.00
838	29-3779	Dep. NTIS (US Sales Only), $3.25
841	29-2635	Dep. NTIS (US Sales Only), $3.75
INR-	(Non-AEC)	
1462	29-3405	Dep. NTIS (US Sales Only), $3.25
1468	29-3895	Dep. NTIS (US Sales Only), $3.00
IRE-	(F.R. Germany)	
2-1973	29-2824	Dep. NTIS (US Sales Only), $3.25
3-1973	29-2574	Dep. NTIS (US Sales Only), $3.50
4-1973	29-2963	Dep. NTIS (US Sales Only), $3.00
IS-		
3182	29-3098	Dep. NTIS, $3.00
3300	29-3454	Dep. NTIS, $5.45
IS-EPA-		
2	29-4747	Dep. NTIS, $5.45
IS-M-		
13	29-4748	Dep. NTIS, $3.00
ITJ-	(Poland)	
38	29-2422	Dep. NTIS (US Sales Only), $3.25
41	29-2789	Dep. NTIS (US Sales Only), $4.50
JAB-	(Non-AEC)	
99-98	29-2613	Dep. NTIS, $5.45
JAERI-M-		
5133	29-4698	NTIS (US Sales Only)
JINR-	(USSR)	
D2-7161	29-4399	
D6-7094	29-4045	Dep. NTIS (US Sales Only), $11.75
E2-7228	29-3686	Dep. NTIS (US Sales Only), $3.25
P1-7027	29-3424	Dep. NTIS (US Sales Only), $3.00
P1-7155	29-3549	Dep. NTIS (US Sales Only), $3.00
P1-7268	29-3425	Dep. NTIS (US Sales Only), $3.75
P1-7342	29-3687	Dep. NTIS (US Sales Only), $3.00
P2-7178	29-3467	Dep. NTIS (US Sales Only), $3.00
P2-7210	29-4400	Dep. NTIS (US Sales Only), $3.00
P2-7211	29-4061	Dep. NTIS (US Sales Only), $3.00
P2-7220	29-3572	Dep. NTIS (US Sales Only), $3.25
P2-7271	29-4401	Dep. NTIS (US Sales Only), $3.25
P2-7293	29-3573	Dep. NTIS (US Sales Only), $3.00
P2-7347	29-3503	Dep. NTIS (US Sales Only), $3.50
P2-7372	29-3524	Dep. NTIS (US Sales Only), $3.00
P2-7424	29-4381	Dep. NTIS (US Sales Only), $3.00
P3-7376	29-3918	Dep. NTIS (US Sales Only), $3.00
P4-6990	29-3919	Dep. NTIS (US Sales Only), $3.00
P4-7109	29-3624	Dep. NTIS (US Sales Only), $3.00
P4-7224	29-3985	Dep. NTIS (US Sales Only), $3.00
P4-7269	29-4062	Dep. NTIS (US Sales Only), $5.50
P4-7312	29-4063	Dep. NTIS (US Sales Only), $5.25
P4-7349	29-3625	Dep. NTIS (US Sales Only), $3.00
P4-7374	29-4064	Dep. NTIS (US Sales Only), $3.00
P4-7386	29-3626	Dep. NTIS (US Sales Only), $3.25
P4-7425	29-4065	Dep. NTIS (US Sales Only), $3.75
P4-7426	29-4749	Dep. NTIS (US Sales Only), $3.00
P6-7173	29-3853	Dep. NTIS (US Sales Only), $3.00
P6-7203	29-2540	Dep. NTIS (US Sales Only), $3.00
P7-7189	29-3986	Dep. NTIS (US Sales Only), $3.25
P7-7279	29-3987	Dep. NTIS (US Sales Only), $3.00
P7-7327	29-3988	Dep. NTIS (US Sales Only), $3.00
P7-7391	29-3989	Dep. NTIS (US Sales Only), $3.00
P12-7164	29-2575	Dep. NTIS (US Sales Only), $3.00
P14-7212	29-2498	Dep. NTIS (US Sales Only), $3.00
P15-7202	29-3394	Dep. NTIS (US Sales Only), $3.00
JPRS-	(Non-AEC)	
60179	29-4512	Dep. NTIS
JUL-	(F.R. Germany)	
959-RW	29-3118	Dep. NTIS (US Sales Only), $8.50
968-CT	29-2584	Dep. NTIS (US Sales Only), $3.75
970-RG	29-4474	Dep. NTIS (US Sales Only), $5.75
975-RG	29-4504	Dep. NTIS (US Sales Only), $10.50
979-RG	29-4475	Dep. NTIS (US Sales Only), $5.50
980-RG	29-4558	Dep. NTIS (US Sales Only), $7.25
981-RG	29-4505	Dep. NTIS (US Sales Only), $4.75
K-		
1845	29-4750	Dep. NTIS, $4.00
1847	29-2600	Dep. NTIS, $5.45
KFK-	(F.R. Germany)	
1654-UF	29-2650	Dep. NTIS (US Sales Only), $7.25
1678	29-2433	Dep. NTIS (US Sales Only), $3.25
1712	29-4699	Dep. NTIS (US Sales Only), $7.00
1758	29-4523	Dep. NTIS (US Sales Only), $3.25
1798	29-3990	Dep. NTIS (US Sales Only), $11.00
1855	29-4751	Dep. NTIS (US Sales Only), $6.75
KFK-EXT-	(F.R. Germany)	
13-73-1	29-4700	Dep. NTIS (US Sales Only), $4.75
23-73-1	29-2632	Dep. NTIS (US Sales Only), $3.00
KFKI-	(Hungary)	
73-33	29-2801	Dep. NTIS (US Sales Only), $3.00
73-40	29-4066	Dep. NTIS (US Sales Only), $3.00
73-42	29-4752	Dep. NTIS (US Sales Only), $3.00
73-43	29-4753	Dep. NTIS (US Sales Only), $3.00
73-52	29-4754	Dep. NTIS (US Sales Only), $3.00
KHFTI-	(USSR)	
72-15	29-2683	Dep. NTIS (US Sales Only), $3.50
LA-		
5245-MS	29-4755	Dep. NTIS, $4.00
5271-PR	29-4679	Dep. NTIS, $6.00
5325	29-4756	Dep. NTIS, $4.00
5326-MS	29-4357	Dep. NTIS, $4.00
5351-MS	29-3162	Dep. NTIS, $4.00
5361-PR	29-4680	Dep. NTIS, $4.00
5407-MS	29-4701	Dep. NTIS, $4.00
5410-MS	29-4702	Dep. NTIS, $4.00
5439-PR	29-3153	Dep. NTIS, $4.00
LA-tr-		
73-40	29-4681	Dep. NTIS, $3.25
73-43	29-4067	Dep. NTIS, $5.50
73-51	29-4757	Dep. NTIS, $5.75

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LA-UR-		
73-692	29-2997	Dep. NTIS, $3.00
73-910	29-4300	Dep. NTIS, $3.25
73-1309	29-2629	Dep. NTIS, $3.00
73-1320	29-3163	Dep. NTIS, $3.00
73-1398	29-3049	Dep. NTIS, $3.00
73-1568	29-3164	Dep. NTIS, $3.00
73-1594	29-4758	Dep. NTIS, $3.25
LBL-		
1493	29-4759	Dep. NTIS, $8.50
1866	29-4760	Dep. NTIS, $13.25
1873	29-3350	Dep. NTIS, $11.75
2066	29-3574	Dep. NTIS, $4.00
2079	29-3525	Dep. NTIS, $6.25
2128	29-2499	Dep. NTIS, $9.25
2135	29-4761	Dep. NTIS, $7.75
2205	29-4762	Dep. NTIS, $4.00
2212	29-3351	Dep. NTIS, $5.75
LMEC-		
73-5	29-2593	AT
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